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TWENTY-FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

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1894.

(PUBLISHED BY ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.)

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WARWICK BROS. & RUTTER, PRINTERS, ETC., 68 AND 70 FRONT STREET WEST.
1894.

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PROFESSOR WILLIAM SAUNDERS, F.R.S.C.

Director of the Experimental Farm of the Dominion of Canada. President of the Entomological Society of Ontario, 1875-86. Editor of "The Canadian Entomologist," 1874-86.

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AUGUSTUS RADCLIFFE GROTE, A.M.,

Honorary Member of the Entomological Society of Ontario (Elected Nov. 10, 1868); Vice-President of the American Association for the Advancement of Science, (1878), etc., etc.

TWENTY-FIFTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

1894.

To the Honorable the Minister of Agriculture:

SIR,—I have the honor to submit for your approval the twenty-fifth annual report of the Entomological Society of Ontario. The Council feels a pardonable pride in drawing your attention to the fact that they have now completed a quarter of a century's work in the investigation of the life histories of insects and their relation to agriculture and horticulture, and have embodied the results of their researches in twenty-five annual reports and twenty-six volumes of the *Canadian Entomologist*. This somewhat uncommon success in the case of a voluntary scientific society is, they feel, largely due to the support which has been received from the Legislature of Ontario, and for which they desire to record their grateful thanks.

The President's address and the various papers on economic and general entomology which are contained in the accompanying report will be found, it is trusted, as interesting and as useful as on previous occasions.

I have the honor to be, Sir,

Your obedient servant,

W. E. SAUNDERS,

Secretary.

OFFICERS FOR 1895.

President	W. H. Harrington	Ottawa.
Vice-President	J. W. Dearness	London.
Secretary	W. E. Saunders	do
Treasurer	J. A. Balkwill	do
Directors :		
Division No. 1	James Fletcher	Ottawa.
" 2	Rev. C. J. S. Bethune	Port Hope.
" 3	Gamble Geddes	Toronto.
" 4	A. H. Kilman	Ridgeway.
" 5	R. W. Rennie	London.
Librarian and Curator	J. A. Moffat	do
Auditors	J. H. Bowman J. M. Denton	do do
Editor of the "Canadian Entomologist"	Rev. C. J. S. Bethune	Port Hope.
Editing Committee	J. Fletcher H. H. Lyman Rev. T. W. Fyles J. M. Denton J. H. Bowman	Ottawa. Montreal. South Quebec. London. do
Delegate to the Royal Society	Rev. T. W. Fyles	South Quebec.
Committee on Field Days	Dr. Woolverton, Messrs. McClement, Elliott and Stevenson	London.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY.

The thirty-second annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 7th and 8th, 1894, the President, Mr W. H. HARRINGTON, F.R.S.C, of Ottawa, occupying the chair.

The meeting was called to order at 3 o'clock p.m. on Wednesday, when the following members were present: Rev. T. W. Fyles, South Quebec; Mr. H. H. Lyman, Montreal; Mr. James Fletcher, Ottawa; Rev. C. J. S. Bethune, Port Hope; Capt Gamble Geddes, Toronto; Messrs. J. M. Denton, J. A. Balkwill, W. E. Saunders, J. A. Moffat, J. W. Dearness, W. Stevenson and H. P. Bock, London. A letter of apology was read from Mr. J. D. Evans, of Trenton, regretting his inability to attend the meeting.

After discussing the question of obtaining more suitable and commodious rooms for the society, which was also considered at the evening session, the first paper on the list was read by Capt. Geddes on "Some of the Insects of Bermuda collected during the Winter of 1893-4." The writer brought a number of interesting specimens to illustrate his remarks. Observations were made upon the paper by Dr. Bethune, who had visited the islands during the two previous winters and had found very few insects of any kind; the only butterflies he saw were *Danais Archippus* and *Junonia Cœnia*, a few Geometer moths and Plusias flying about the lantana blossoms at dusk, and some beetles of the family Scarabaeidæ. As Capt. Geddes's visit had extended over four months his opportunities were very much greater and he had succeeded in making a very interesting collection.

Capt. Geddes gave an account of a remarkably late brood of the Camberwell Beauty butterfly, *Vanessa Antiopa.* He found the larvæ feeding on the yellow and partly faded leaves of a young elm tree in his garden, which they nearly stripped of its foliage; many of the caterpillars fell to the ground with the falling leaves on which they fed. The butterflies from this brood came out in the house on the 6th and 7th of November.

Mr. Lyman gave an account of his observations of the various broods of *Vanessa Milberti.* Hibernated specimens of the butterfly appear in early spring; the first brood from these was flying on the first of July, and colonies of larvæ were found feeding on nettles early in the month. Very young larvæ were found again on the mountain at Montreal on the 20th of August; these became full grown on the 13th of September and changed to pupæ on the 18th. Late in October the full colors of the butterfly were showing through the chrysalis case, but when he left home on the 5th of November, the butterflies had not emerged. Mr. Scudder, in his work on butterflies, states that this species has three broods in the New England States. Mr. Lyman thought that those now in the pupa state were the third brood at Montreal.

Dr. Bethune exhibited some specimens of rare Lepidoptera that he had taken this summer. Among them were *Limenitis Proserpina*, captured at Roach's Point, Lake Simcoe, on the 22nd of August; *Sphinx luscitiosa*, attracted by light at Port Hope, in June; a variety of *Catocala ilia* taken at sugar in July; *Plusia venusta*, Walk. (*striatella* Grote), attracted by light; an immaculate specimen of *Pieris rapæ*, etc. Mr. Fletcher stated that *L. Proserpina*, though excessively rare, had been taken at Rideau Hall, Ottawa.

Mr. Lyman read an interesting paper on "Common Names for Butterflies, Shall We Use Them?" In the discussion that followed Mr. Fletcher stated that common names would be given for all the Canadian species of butterflies in the handbook that he and Dr. Bethune were preparing for publication. The general opinion of those present was that it is highly desirable that ordinary English names should be used as far as practicable in order to promote the study and observation of insects.

Dr. Bethune then read "A List of the Butterflies of the Eastern Provinces of Canada," which contained no less than 116 species, of which the localities and in most cases the food plants and times of flight were given. The paper was commented on by Capt. Geddes, Messrs. Fletcher, Fyles and Lyman, who contributed much interesting information regarding a number of the species.

Mr. Fletcher exhibited specimens and gave an account of the remarkable habits of the moth *Exyra Rolandiana*, the larva of which feeds upon the leaves of the pitcher plant, *Sarracenia purpurea*. He also exhibited an interesting collection of butterflies sent by Mr. Green, of British Columbia, and gave an account of a visit he made to Sudbury in May last, when, notwithstanding a snow storm that prevailed, he procured the larva of *Pamphila metacomet*, which fed on carex, and which he succeeded in rearing. He made some interesting remarks upon *Colias elis*, *nastes* and *interior*, and gave an account of a rearing of *Colias eurytheme*, the eggs of which he had obtained at Nepigon in June. When the chrysalids were beginning to show the color of the butterfly he retarded their development for some weeks by placing them in a refrigerator, while emergence was hastened by exposure to electric light. He also showed some specimens of *Papilio Bairdii* and *P. Oregonia* received from Mr. Edwards, who had this year added yet another to his laurels by proving that these very dissimilar butterflies were really dimorphic forms of one species. Mr. Edwards had gone to Colorado and with great care had bred broods of larvæ from eggs laid by both forms and had obtained from each brood some of both kinds of the butterflies named. This, the speaker said, he considered one of the greatest triumphs of this wonderful man. He had had the great pleasure of meeting Mr. Edwards in his own beautiful home amongst the mountains of West Virginia, where he hoped he would long be spared to carry on his useful studies with his characteristic energy, perseverance and accuracy.

Mr. Fletcher next exhibited specimens of *Pamphila metacomet* in all stages, egg, larva, pupa and cocoon and perfect butterfly, as well as an egg parasite, which had been named by Mr. Ashmead *Telenomus pamphilæ*, n.s. It was agreed at the last annual meeting that each member should try to work out the life history of at least one insect in time for this meeting: he had devoted his attention to *P. metacomet*, which is as a rule rarely taken at Ottawa. This fact, however, he thinks has been due to a want of knowledge as to its habits. He had previously taken the butterfly only in open glades in a wood, but the larvæ feed on carices growing on exposed rocks. The food plant of this species as well as that of *P. mystic*, which he had also bred this year, was, he thought, not grasses, but sedges (carex), although in confinement they would eat grasses. The eggs are laid in July and the caterpillar passes two or sometimes three moults the same autumn and then hibernates in a case made by spinning three or four of the leaves of the food plant together. The larva is pale green, closely lined all over with broken white lines and covered with minute black piliferous tubercles. The most remarkable part of the larva is the head which is ornamented differently from that of any other species of the genus he was acquainted with. On the front, at the apex, is a large, velvety black area edged with white, and down either side of the face run two white lines with a dark area between them; behind these lines the head is black. The thoracic shield is ribbon-like, double, white in front, black behind. Just previous to pupation two large, white patches were plainly visible through the skin beneath segments 11 and 12. When ready to pupate the larva spins a close cocoon, similar to that of *Acronycta oblinita*, the end of which is stopped up with a silvery white, flakey powder which is emitted through the skin (apparently) from the two white patches mentioned. In three or four instances the pupa worked its way out of the cocoons and fell to the ground. It is piceous, when cleaned of the white silvery powder, slender and much elongated. The tongue case protrudes beyond the wing cases as in *Pamphila cernes*, etc. The abdomen beneath is closely covered with tawny bristles which are thickest at the cremastral end. The end of the body is furnished with about six short blunt spikes and on each side two larger ones. A more detailed account of the stages will appear later in the *Canadian Entomologist*.

The Rev. T. W. Fyles read a short paper on "*Catastega aceriella-Semasia signatana*." In answer to an enquiry whether *Nematus Erichsoni*, the Larch saw-fly, was still at work, he stated that it was still operating in the Province of Quebec, but in greatly reduced numbers. A tree here and there had been stripped this summer; in some cases part of the tree only had been affected. The insects were now attacking young trees—those from about ten to twenty or more feet in height. They seemed on their first arrival to pass by these, he supposed because the foliage of the more mature trees was more palatable to them. Some trees near Quebec that had been badly attacked and that he once thought would die, seemed to have made a struggle for life and had sent out numbers of small twigs on the stems and main branches, so as to present a very scrubby appearance. He had not been able to visit the large swamps in the Townships, but he believed the state of things there to be such as he had described in the society's Reports. He had been surprised to find in parts of the Gomin swamp affected by drainage numbers of small tamaracks from six inches to several feet high, where a few years ago none were to be seen. Mr. Harrington stated that in Cape Breton also he found young tamaracks growing up.

Mr. Fyles next gave an account of a strange food for the larva of *Pyralis farinalis*. He said that in the society's Report for 1893, page 42, he gave a description of a *Lithocolletis* larva that he found feeding in blisters on the leaves of the white hazel, and which he hoped to rear. When full fed the larva spun a cocoon inside the blister, but his hope of obtaining the perfect insect was defeated in a strange manner. One the 3rd of March he examined the glass jar in which he had stored the blistered nut leaves, and over which he had tied a muslin cover. To his great surprise he found a number of Pyralid larvæ feeding upon the leaves. He described them as follows: Length, when extended, nine-tenths of an inch; head and prothoracic and anal plates, nut brown; the rest of the body. lead color: dorsal line. black. The appearance of the larvæ seemed familiar to him, but he let them be. They ate up the nut leaves, leaving only a tangle of the ribs and veins. In due time they produced a number of fine specimens of the moth *Pyralis farinalis*, Linn.

Mr. Fyles stated that he wished to rectify a mistake. In the list of captures on page 41 of the annual Report for 1893 occurs the name *Anisota senatoria*; it should be *Anisota virginiensis*, Drury.

Mr. Harrington exhibited a collection of beetles from Japan, many of which were very beautiful and remarkable.

Mr. Lyman showed a box of specimens collected by Mr. Bean, at Laggan, Alberta, among which was a series of the moth *Nemeophila petrosa*. An excellent photograph of these had been made, and it was resolved, on motion of Mr. Fletcher, seconded by Dr. Bethune, that Mr. Lyman be requested to have a plate prepared for publication in the *Canadian Entomologist.*

Mr. Fletcher exhibited a small collection of diurnals which had been sent down for identification by Mr A. W. Hanham, of Winnipeg. Attention was drawn to specimens of *Thymelicus Garita*, this being probably the most eastern record; *Lycæna Melissa*, *Thecla Acadica* and three specimens of *Thecla strigosa*, all of which showed the large fulvous spots similar to the specimen figured by Boisduval and Leconte as *T. Liparops*. This form was very rare at Ottawa, the speaker having taken only two specimens in many years.

While on his feet Mr. Fletcher said he wished to mention that a good deal of work had been done during the past season in collecting insects in distant places in Canada.

Mr. A. P. Low, of the Geological Survey, had made a collection of diurnal Lepidoptera and Coleoptera in his journey across Labrador, specimens of *Pyrgus centaureæ*, *Chionobas jutta* and *Colias Scudderii* were exhibited. Dr. G. M. Dawson and Mr. J. McEvoy had collected in the mountains about Ashcroft, B.C.; Messrs. C. de B. Green and Edmund Reynolds had made large and valuable collections of Lepidoptera in the mountains at Osoyoos, B.C., just north of the boundary of Washington State. Specimens were exhibited of *Papilio Daunus*, *Oregonia*, *Rutulus var Arizonensis*, *Turnus*, *Satyrus Œtus*, *S Ariane*, *Lycæna sagittigera*, *L. Heteronea*, *Pieris Beckerii*, *Colias Emilia*, *Anthocaris Sara*, *A. creusa*, *Thecla dumetorum*, *Pterogon Clarkiæ* and many other rarities. Mr. Fletcher was glad to be able to announce that Mr. Green intended next year to collect as a business. His address for the present is Osoyoos, B.C., and intending purchasers would do well to correspond with him at once. Mr. Green and Mr. Reynolds had both added new species this year to the Canadian list. At Calgary Mr. C. Wolley-Dod had done good work in collecting and providing Mr. W. H. Edwards with eggs of *Chionobas Alberta*, the larvæ from which had been successfully taken through all their stages. At Olds, 40 miles from Calgary, Mr. T. N. Willing had also done good work, and had taken, among other rarities, *Erebia discoidalis* and *Argynnis Edwardsii*. Prof. John Macoun had this year collected at Crane lake, in the same district, and had added *Hipparchia Ridingsii* to the Canadian list. In Alaska collections of insects had been made by Messrs Otto Klotz and W. Ogilvey, of the Boundary Survey, as well as by some of the other members of the party This material was chiefly diptera, coleoptera and hymenoptera. It had not as yet been worked up. In the Rocky Mountains Mr. T. E. Bean continued his studies. Through his kindness eggs had been received by the speaker of *Colias Elis*, of which bred specimens of the larvæ and imago were exhibited, *Colias nastes* and other rare species. Some beautifully blown larvæ prepared by Mr. Bean were shown. Mr. W. McInnes and Mr. J. O. Guillim, of the Geological Survey, had collected east of Port Arthur, the latter gentleman taking *Euptoieta Claudia* at Wabigoon, on the C. P. Ry. In Manitoba collections had been made by Mr. Hanham at Winnipeg, and a very remarkable collection by Mr. E F. Heath, near Cartwright, Man., some most surprising captures had been made as *Vanessa Californica*, *Nathalis Iole*, and a Thecla which is probably undescribed. Mr. Heath has also sent the cocoons of some splendid specimens of *Samia Columbia* which were exhibited, and compared with specimens found at Ottawa on tamarack. The northwestern food of this species is *Elæagnus argentea*, and the moths are always distinguishable by their much redder hue.

Mr. Harrington gave some interesting "Notes on Canadian Coleoptera," relating how he had obtained a hair snake from a Coccinella, and found the larvæ of a beetle, *Brachyacantha ursina*, feeding upon plant lice in an ant's nest, with other noteworthy matters, which will be found detailed in his paper.

The meeting adjourned at 6 o'clock p.m.

EVENING SESSION.

In the evening the society held a public meeting in its rooms in Victoria Hall, at which there was a largely increased attendance of members, between thirty and forty being present. Besides those already mentioned at the afternoon meeting, the following were noticed: Messrs. R. W. Rennie, J. G. Wilson, J. H Bowman, Dr. S. Woolverton, J. H. Pearce, W. T. McClement, W. Scarrow, etc.

The chair was taken by the President, Mr. Harrington, at 8 o'clock. After apologizing for the absence of Mr. Kilman and Mr. Evans, the Chairman called upon the Secretary to read the

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year:

They are happy to congratulate the members of the society upon the steady increase in numbers which continues to take place, and the hearty interest that is maintained in the various departments of work.

The twenty-fourth annual report on Economic and General Entomology was presented to the Minister of Agriculture in November last, and was printed and distributed at the beginning of January. It consisted of one hundred and eleven pages, a much larger number than usual, and was illustrated with thirty-nine wood cuts and a portrait of the Editor, who was for several years President of the society. Among the more important and interesting papers may be mentioned Mr. Fletcher's account of "The Injurious

Insects of the Year 1893"; the President's Address; "Entomological Mistakes of Authors," by the Rev. T. W. Fyles; "Mosquitoes," by Mr. Moffat; "Dragon Flies," by Mr. McLaughlin; "A Contrasted Summary of the Main External Characters of Butterflies in Their Different Stages of Life," by Mr S. H. Scudder, and a report of the fifth annual meeting of the Association of Economic Entomologists, together with a number of the principal papers.

The *Canadian Entomologist*, the monthly magazine published by the society, has been regularly issued at the beginning of each month, and completed its twenty-fifth volume in December last. It consisted of 334 pages, being the largest number yet published. Of the twenty-sixth volume eleven numbers have already been issued; the increase in the number of pages has been more than maintained, 328 having been already published. No less than fifty two wood cuts have been used to illustrate papers. a large proportion of them being new and original. Among the many valuable and interesting papers that have been published, mention may especially be made of the series of illustrated articles on the "Coleoptera of Ontario and Quebec," by Mr. Wickham, which are intended especially to assist beginners in naming their specimens, and to lead them on to a more thorough study of the order. The list of contributors includes the names of the most eminent entomologists in North America, as well as several in Europe.

The collections of specimens belonging to the society have been increased during the past year by the addition of a number of coleoptera new to the Canadian lists by Mr. A. H. Kilman, of Ridgeway, and a collection of insects from San Domingo. Improvements are also being steadily made by the substitution of fresh specimens for those that are faded or imperfect in the cabinets.

The geological, microscopical and botanical sections of the society have held regular meetings during the past season and have done much good work, as is shown by their respective reports. It is to be regretted that the ornithological section has not been so active as in former years, but it is trusted that interest in this department will speedily be revived.

The treasurer's report is highly satisfactory. The expenditure on the *Canadian Entomologist* has necessarily been increased by its enlargement, but this has been fairly met by the steady growth in the number of subscribers and by the sale of back volumes. The balance on hand at the close of the financial year is $360.50. This will be entirely absorbed by the necessary expenses of the remaining months of the year. The Council take this opportunity of recording their appreciation of Mr. Balkwill's services as treasurer and the satisfactory mode in which his accounts are kept.

The society was represented at the annual meeting in Ottawa of the Royal Society of Canada, in May last, by the Rev. T. W. Fyles. We have much pleasure in recording that two of our members were elected fellows, namely, our President, Mr. W. H. Harrington, and the Rev. G. W. Taylor, of Nanaimo, B.C.

All of which is respectfully submitted.

W. E. SAUNDERS,
Secretary.

REPORT OF THE LIBRARIAN AND CURATOR.

Mr. J. A. Moffat presented and read his report as follows:

I beg leave to submit my report for the year ending 31st of August, 1894.

Seventy-seven volumes have been added to the Library during the year; these include bound volumes received from public institutions and scientific societies, exchanges collected and bound, also books obtained by purchase.

The more important of the bound volumes received are, The Reports of the Missouri Botanical Garden for the years 1891 and 1893.

Annual Report of the Ontario Department of Agriculture for 1892.

The Smithsonian Report for 1891.

Report of the New York State Entomologist for the years 1891 and 1892.

Report of the New York Agricultural Experiment Station for 1892.

Reports of the New York State Museum for the years 1892 and 1893.

Proceedings and Transactions of the Royal Society of Canada for 1893.

Iron-bearing Rocks of Minnesota.

Added by purchase: A popular handbook of the Ornithology of the United States and Canada, based on Nuttall's Manual: by Montague Chamberlain, 2 volumes. All the Entomological writings, up to date, of J. W. Tutt, F. E. S., England, editor of "The Entomological Record and Journal of Variation." Also his instructive and amusing book entitled, "Random Recollections of Woodland, Fen and Hill": seven volumes in all. These were obtained in exchange for back volumes of the *Canadian Entomologist*.

There are now four hundred and eighty-five pamphlets in the Library, bound in twenty-seven volumes. These volumes are labelled "Pamphlets," and numbered consecutively from 1 to 27, but have their number in the Register according to the time they were bound and placed in the Library. The pamphlets are numbered in order, and catalogued in a book by themselves, giving the Library number as in the Register, the number of the pamphlet volume, the pamphlet number, with the author's name, the subjects, and the date of issue where obtainable.

The whole number of volumes on the Register is now 1,361. The number of volumes issued to local members during the year was forty-four.

Additions are still being made to the Society's collection of native lepidoptera by the capture of species hitherto unrepresented therein; twenty named forms being added during the year, which had not before been published as Canadian. There are now 1,077 named forms in this department, as against 930 in 1892. A steady improvement in the quality of the collection is also being made by the replacing of such as are not in perfect condition, with fresh material obtained by capture or exchange.

The first important addition to the Society's collection of native Coleoptera for several years was made by Mr. A. H. Kilman, of Ridgeway, Ont., in a donation of a hundred and fifty species.

A small but highly interesting collection of Santo Domingo insects was presented to the Society by a friend, the captures of his sister, Miss Davida Rougoie, who is at present a resident of that island. The most noticeable feature of it being three specimens of *Mantis* of strikingly different form, color and ornamentation, indicating that it is an abundant family in that locality.

Through the kindness of Mr. A. P. Morse, of Wellesley College, Mass., the Society has been put in possession of representative specimens of three species of New England *Spharagemon*, also his paper, historical and descriptive, of the same.

All of which is respectfully submitted.

J. ALSTON MOFFAT,
Librarian and Curator.

The President then read his annual address, which was listened to with great interest and attention:

ANNUAL ADDRESS OF THE PRESIDENT.

By W. Hague Harrington, F.R.S.C., Ottawa.

> "An ant slow-burrowing in the earthy gloom,
> A spider bathing in the dew at morn,
> Or a brown bee in wayward fancy borne
> From hidden bloom to bloom."
>
> —*Lampman.*

Gentlemen,—My first duty to the members of the Entomological Society is to sincerely thank them for the honor which they conferred upon me in re-electing me to be their President, notwithstanding my inability to be present with them at the last annual meeting. Those among you who may afterwards have read my address, as printed in the Annual Report, may perhaps have congratulated yourselves that I did not appear at the meeting and read it to you in extenso. You need not, however, be alarmed lest you have to listen to such an over-lengthy document on this occasion.

My good friend, Mr. Fletcher, has kindly consented to address you on the injurious insects of the past season, and thus I am relieved of a task for which he is more competent, and for which his official duties so fully qualify him. You shall, I rest assured, find his remarks to be most interesting and profitable to you, both as regards economic and scientific questions.

The Report prepared by the Council will inform you as to the work performed by the Society during the year, and as to its present financial standing and prospects, so that, with regard to these points, I need merely express my sense of a lively satisfaction in the knowledge that continued prosperity and success crown the efforts which you are making to advance an interest in, and a truer knowledge of the attractive and deeply interesting science of entomology, for the study of which you have been banded together for so many years.

After careful consideration of several topics which occurred to me as worthy of your attention, I decided that a brief review of the results of the past twenty-five years might not be unprofitable. I shall base my remarks upon the volumes of the *Canadian Entomologist*, and shall afterwards endeavor to indicate the direction in which future work may be advantageously undertaken. The splendid series of twenty-five volumes of the *Canadian Entomologist*, which have already been completed, constitute a veritable treasure-house of information regarding the insects of North America. The value of their pages has been greatly increased by the constant contributions from the leading entomologists of the neighbouring Republic, and by frequent articles from European correspondents. The valuable papers received from these sources have dealt largely with the Canadian fauna, and have often been based upon the captures of our members in Canada, but my present remarks will be confined to a discussion of the work of our home members as recorded by themselves. These laborers have ever been few in proportion to the vast extent of country of which it is our privilege and duty to investigate the insect life. We need not be surprised, therefore, because the investigated districts are very limited in comparison with the still unexplored fields which are waiting to yield up their treasures to the careful investigator. The areas in which systematic and sustained work has been done are, in fact, so few and so limited in extent, that on a map they appear almost as mere starting-points.

It is worthy of note that the labors of editing the twenty-five volumes of the *Entomologist* have devolved equally upon Prof. Saunders and Dr. Bethune; each of these gentlemen having edited twelve volumes and shared in the editing of volume eighteen. The Society has owed much to the zeal and work of these gentlemen, whose contributions appear in nearly every volume, and much exceed the efforts of any other member. Among their contributions are many valuable papers on our lepidoptera, containing descriptions of their earlier stages, and also of some new species. Another series of very interesting and valuable papers was that "On Some of our Common Insects," designed to arouse the interest of some of those who might be taking up the study of entomology, and to stimulate them to become earnest workers. We are glad to know that these learned friends, who have, in the past, done so much for our Society and for the study of entomology, are still connected with us in the work which we are carrying on. Dr. Bethune continues to be our efficient editor, and under his wise and careful direction our publication continues steadily to improve, and to hold a foremost place in entomological literature. Prof. Saunders, although called to a position making great demands upon his time and strength, still keeps up his interest in our special line of scientific work. A few years ago he embodied his researches in that excellent treatise on "Insects Injurious to Fruits," which, since its appearance, has been a standard work, and has had a very large circulation throughout North America.

One of the most useful and important features of the earlier volumes was the compilation by Dr. Bethune, from Kirby's Fauna Boreali-Americana, of the "Insects of the Northern Parts of British North America" (afterwards republished as a separate volume), which placed the descriptions of a great many of our insects in the hands of students who might not otherwise have been able to obtain them, the original publication being very rare.

Before commencing this address I made a list of some fifty Canadian contributors, the majority of whom still continue to send in valuable papers. Several, however, have passed to the "Happy Hunting Ground" beyond the "Great Divide," while others have either removed from the Dominion, or through pressure of business and new occupations, have ceased to contribute; though in some cases still keeping up their collections and their interest in the study and work of the Society. My intention is not to go at length into the writings of individual members, nor can I make any reference to the many valuable papers specially prepared for the Annual Reports furnished to the Ontario Government. But I shall try to bring my subject before you in two ways: first, from a geographical standpoint, that you may see in what districts our insects have been studied; secondly, from a systematic point of view, that you may see which orders have received attention, and which have been, in whole or in great part, neglected.

As our Society is provincial, in so far as regards its name and the liberal support which it annually receives from the enlightened Legislature of Ontario, so the larger portion of the work accomplished by it has naturally related to the insects of the Province in which it was organized and by which it is sustained. A good starting-point for our proposed tour of inspection will be London--the beautiful city in which we are now met, and which, as the headquarters of the Society, has been for many years the Entomological Mecca to which we annually resort to renew our strength and zeal in the good work, and to arrange our plan of campaign for the coming year.

Here Prof. Saunders toiled for many years, and, with the later assistance of his sons, made most extensive collections. His papers do not, however, include any lists of the species which he collected in the various orders, and the same remark may apply to Messrs. Denton, E. Baynes Reed, Williams and others whose captures have so largely enriched the collections of the Society. The London members, however, had for many years almost the entire management of affairs of the Society, and the preparation of the Annual Reports; the arrangement of the collections, the care of the library, etc., occupied much time that might otherwise have been devoted to special lines of research.

At Grimsby Mr. J. Pettit, in the earlier years of the Society, was a very skilful and assiduous collector, and his list of the coleoptera taken in that neighborhood, which he commenced in the first volume, is one of the most complete local catalogues yet published in Canada. The Hamilton district has been investigated by such competent collectors as Messrs. Moffat, Murray, Johnston and Hanham. The first of these gentlemen has made many valuable contributions to our publications, and is now continuing his good work in London, where he has the charge of the collections and library. Mr. Geo. Norman, of St. Catharines, published a very interesting list of the Noctuidæ captured there by him. At Ridgeway we find a member of our Council, Mr. A. H. Kilman, who has made extensive collections in what seems to be a very rich district; but while he has added largely to the knowledge of our insects, he has not yet published as much regarding them as we should like him to do.

Toronto, as the chief City in Ontario and the seat of various and important institutions of learning, should furnish us many capable investigators, but I find that the workers there have never been numerous; nor do the local natural history societies appear to have done much to develop them. I must mention, however, our first President, Prof. Croft, with Mr. W. Brodie and Capt. Gamble Geddes. Mr. Brodie has accumulated large collections, and he has published a few interesting articles in our magazine (and more recently in the "Biological Review of Ontario,") upon various gall-forming insects. Capt. Geddes has been a most enthusiastic gatherer of lepidoptera, amassing a collection of butterflies unequalled in Canada, and which has since been purchased by the Geological Survey of Canada. His interesting papers upon Canadian butterflies appear in several volumes of the *Entomologist.*

Port Hope has been the home of Dr Bethune, so we may rest assured that the country round about has been well investigated. I have not yet had the pleasure of seeing his fine collections, and as regards the extent and value of his writings upon our insects I have already spoken. At Belleville we have had such well-known collectors as Prof. J. J. Bell and Prof. Macoun. The former paid much attention to the smaller forms of coleoptora, and was a frequent contributor to the *Entomologist.* As for Prof. Macoun, he is now a naturalist of world-wide reputation, who has been most assiduous in making known the fauna and flora of the Dominion, and although the great demands upon his time do not permit him to continue the study of entomology, he still continues, I am glad to say, the collection of insects as opportunity permits. In the neighboring town of Trenton very careful work has been done by Mr. J. D. Evans, one of the most thorough collectors with whom I have corresponded, and whose collections are models of neatness and skill, in mounting and arrangement.

A branch of the Society formerly existed at Kingston, but I do not find the record of any work except by Mr. R. V. Rogers, from whom we have had several interesting papers. With such a well-known university as Queen's located in the city, there should be more activity in the development of the natural history of the locality. Ottawa in the early days of the Society was the residence of one of our most noted collectors, the late Mr. B Billings, who was a contributor to Vol. I. His collections were extensive and were very carefully and skillfully prepared, but death cut short his labors, and his collections were mostly destroyed through want of proper care on the part of the Society into whose hands they passed. Of recent years there has been an active, if not large, body of investigators, who have striven to develop a full knowledge of the local fauna, and who have been able to do some useful work in other directions. Prof. Saunders is now there, as Director of the Experimental Farms, in connection with which our good friend, Mr. Fletcher, holds the position of Entomologist and Botanist. The value and authority of his official work, and his enthusiasm in all entomological matters, are recognized by every entomologist. Your out-going President is also to be found in the Capital, when at home, but it would not be quite the correct thing to give any opinion on his work, as you might think me a prejudiced judge. The Ottawa Field-Naturalists' Club, organized in 1879, has always had an Entomological Branch, and several other of its members are doing fair work, among whom I may cite Mr. T. J. MacLaughlin, one of the few collectors of odonata in Canada. Several entomological lists, with numerous reports and papers have been published in the *Transactions* of the Club (now the *Ottawa Naturalist*), and Mr. Fletcher has now ready for publication a complete catalogue of the Ottawa butterflies.

Occasional workers have been stationed at other points, as, for instance, Rev. V. Clementi at North Druro, Mr. N. H. Cowdry at Stratford and Mr. B. Gott at Arkona. In the Lake Superior region the only sustained work has been by Mr. Evans at Sudbury, where he made a most interesting, and fairly complete, collection in several orders. Many rare insects have been captured by him and it is much to be regretted that he has not yet found time to publish the lists which he has had in preparation. Nepigon has several times been visited by Mr. Fletcher, and in one of the annual reports can be found an interesting account of the work done there. Dr. Bethune has also published observations made during a trip to Lakes Huron and Superior.

In the adjoining Province of Quebec we find the work of the Ottawa members naturally extending across the Ottawa river to a country which within a few miles is diversified by outlying spurs of the Laurentians, with some consequent change in the flora and fauna. A strong branch of our society is located in Montreal where much effective work has been done by the resident entomologists. It is only a few years since the branch sustained a great loss in the death of their former President, Mr. Bowles, who had made a study of the lepidoptera of the Island of Montreal, and had written frequent papers on the species collected. Mr. Lyman, who I am glad to see with us to-day, has for several years been the President and has shown great interest in its success, and in the continuance of its meetings. He has made a careful study of the lepidoptera, and has accumulated a splendid collection, while his contributions to the *Entomologist* have been numerous and of unusual interest. The late Mr. Caulfield was an industrious collector, and careful observer, who contributed severable valuable lists and other papers, relating chiefly to the insects of the Island of Montreal. Another member who resided there was the late Mr. W. Couper (also of Quebec and Ottawa) a frequent contributor to our earlier volumes. Among other Montreal workers may be mentioned Messrs. Jack, Winn, Hausen, Gibb, Wintle, etc. The Natural History Society has always taken some interest in entomology, and on its annual field-day encourages by suitable prizes the collection of insects by the young people. The *Canadian Naturalist and Geologist* and its successor the *Canadian Record of Science* have from time to time published entomological papers, such as the late Mr. Ritchie's list of local coleoptera, Mr. Caulfield's paper on Canadian orthoptera, and Mr. Hausen's list of coleoptera collected at St. Jerome.

Going down the St. Lawrence we reach Quebec, the scene for many years of the labors of the late Abbe Provancher, whose Faune Entomologique is a monument to his industry and perseverance in the collection and study of our insects, under more than usual difficulties and discouragements. Mr. Bowles and Mr. Hanham also formerly resided in Quebec, and at present we are well represented there by the Rev. T. W. Fyles, a very industrious observer, who has frequently charmed us by the scholarly papers read at these meetings, to be present at which he does not hesitate to take the long journey from the Ancient Capital. The late Mr. Couper made collecting trips to Anticosti and the shores of the Lower St. Lawrence, the results of which appeared in our earlier volumes.

In the Maritime Provinces our only contributors appear to have been Mrs. Caroline E. Heustis of St. John, N.B., and Mr. J. Matthew Jones of Halifax, N.S. The catalogues of the British Museum and other scattered entomological literature show that considerable collections have been made in those provinces, chiefly by officers of the army and navy, and it is matter of regret that there are no resident entomologists, to make a closer study of the insect life, which my own occasional observations prove to be very interesting in many particulars.

Turning westward again to that immense country which stretches from our fair province to the far Pacific, the localities which have been investigated are almost lost in the vast expanse of yet unexplored territory. Mr. Hanham, who formerly collected in Ottawa, Hamilton, Paris and Quebec, has recently removed to Winnipeg, and intends to devote every opportunity to making known its insect life. Capt. Geddes a few years ago made most valuable collecting trips across the prairies and to the Rocky Mountains, and at Laggan, Alta., Mr. Bean is industriously collecting, and adding to our knowledge of the mountain fauna. Both of these gentlemen have, however, devoted themselves chiefly to the study of the lepidoptera, and we have yet to wait for resident entomologists, stationed at moderate distances apart, to gain an adequate idea of the general distribution of the insects of all orders.

On the Pacific coast the Canadian gleaners are also few, although a rich and abundant insect life rewards the labors of the collector. Our chief worker has been the Rev. G. W. Taylor, who has made large collections of lepidoptera, hymenoptera and coleoptera, including many species new to science. These collections were chiefly made in the vicinity of Victoria, V.I., but Mr. Taylor has recently removed to Nanaimo, and has thus a new field of investigation open to him. Mr. W. H. Danby of Victoria is also an energetic collector, and our former associate in the Council, Mr. E. Baynes Reed, now resides at Esquimalt, a few miles from Victoria, and although he has not yet sent to us any account of his work, I know that he is making collections. The recent organization of a Natural History Society in Victoria may stimulate a further interest in Entomology, indeed I believe that a catalogue of the butterflies of Vancouver Island has already been published in the transactions of the Society. Several hundred miles to the north, at Masset in the Queen Charlotte Islands, there is a very careful and competent collector, the Rev. J. H. Keen, who in this farthest outpost has made most interesting discoveries, especially in coleoptera.

A considerable knowledge of the insects of the remoter regions of the Dominion has resulted from the collections made by various members of the staff of the Geological Survey; prominent among whom may be mentioned Dr. Dawson, Dr. Bell and Prof. Macoun. There has not yet been any regular entomological work done in connection with the Survey, and it cannot be expected that the collections of insects, which are made in addition to the regular field work, should be very large or comprehensive. But our thanks are no less due to the gentlemen who have aided; for even a few specimens brought in occasionally, from the distant points reached by these explorers, may do much to help in ascertaining the geographical range and distribution of species. Reference to Volume XXII of the *Entomologist* will show that quite a long and useful list of coleoptera was obtained by collating the various short lists published in the Survey Reports. When the Dominion Museum is housed in correspondence with the value of its great collections, and room is afforded for the display of the natural history specimens collected, the explorers will feel a greater interest in the securing of specimens, and a department of entomology will probably soon be installed.

Having now made a rapid, and necessarily imperfect, survey of the districts which our members have explored in the past, or which they are still investigating, let us change our point of view, and, for a few moments, consider what attention has been bestowed upon the several orders, into which it has pleased systematic entomologists to separate the great and almost inexhaustible complex of minute forms, which are known to us under the general term Insects. From the twenty-five volumes of the *Entomologist*, I have made a list of the papers which seemed to me to be of most importance in helping us to a knowledge of the position of our workers in regard to the investigation of the several orders. The list (appended) is by no means a complete one, as numerous short papers, notes on the occurrence of species, and interesting correspondence have been omitted; my object not being to make an index of papers.

It is found that the contributions dealing with lepidoptera probably equal, in number and volume, those relating to all the remaining groups. This, however, is not surprising, for to this order belong the most beautiful examples of all terrestrial life; flowers of the air, their wings decked with all the hues that blossom or gem can show; as they wing their brilliant flight through the glad summer days, or hover radiantly over the fragrant blooms, they naturally appeal to every heart which is warmed by the least vestige of artistic or poetic taste. Dull and debased indeed in feeling, and most sincerely to be pitied, must he be who sees not some beauty, feels not something of inward pleasure, in beholding these wonderful atoms of grace and brightness.

> "The dreamy butterflies
>   With dazzling colours powdered and soft glooms,
> White, black and crimson stripes, and peacock eyes,
>   Or on chance flowers sit,
> With idle effort plundering one by one,
>   The nectaries of deepest throated blooms."
>
> —*Robert Bridges.*

Apart also from their beauty of form and richness of ornament in the winged state, the lepidoptera furnish the most interesting and attractive examples for the study of the development and life of the insect, from the egg to the imago. In the larval stage they also play a most important part in the economy of nature, and make man pay tribute in varied and large measure. Yet even in this favorite order there remains plenty of work for our entomologists, and far from discouraging those who are engaged in such attractive studies, I would urge them to perfect their knowledge by careful observations on the early stages of our lepidopterous friends and foes, so that they may make their light to shine for the guidance of their fellow students.

Next to the butterflies, the beetles have ever been the favorite prey of the budding entomologist. Very numerous, varied in form and habits, yet easy to collect and preserve, they yield themselves most readily to the formation of an attractive and easily cared for collection. The coleoptera have for these reasons been so thoroughly collected in northern countries, that there remains, even in Canada, a very small percentage of species not already known to entomologists. Even microscopic species from most remote localities, with few exceptions, prove to have received a name and character—even if the character may occasionally not be a good one, or sufficient to qualify the beetle for the position in which it has been placed. Yet there remains abundance of work for our coleopterists in the more careful collecting of the smaller species, and the preparation of accurate local lists, and especially in the study of the early stages of our beetles, since the complete life history of comparatively few species is known.

"Among the yellow pumpkin blooms, that lean
Their crumpled rims beneath the heavy heat,
The striped bees in lazy labor glean
From bell to bell with golden-feathered feet."
—*Lampman.*

Of recent years more attention has been directed to the study of the hymenoptera, and interest in these insects has been stimulated by the publication of several fine works. The publication by Cresson of a synopsis of the families and genera, and a catalogue of the described N. A. species has much facilitated the determination and arrangement of collections, but species are being so rapidly discovered and described, that a new edition will soon be necessary to make it conform to the present knowledge of the order. To our younger members, who have not yet settled upon any special line of investigation, I would strongly recommend the consideration of this order, to which my own attention has been chiefly given for several years. The species are very numerous, more so even than the beetles, and the habits of its members are of wonderful variety and interest. From the bees, wasps and ants, with their well developed mental faculties and their highly organized family communities, we pass to microscopical forms of which a score may develop in a single butterfly-egg. The study of these insects is most absor ing, and inexhaustible fields of enquiry are open. It would be very encouraging to see more students attracted to this order; taking up special families, and by sustained and serious researches aiding in the elucidation of many perplexing problems.

"Mist of grey gnats that cloud the river shore
Sweet even choruses, that dance and spin
Soft tangles in the sunset."
—*Lampman.*

Apart from the three orders to which reference has been made, there has been but a meagre investigation of our insects, notwithstanding their claims to a due share of attention. The diptera are numerous in species and individuals, of much diversity of habit, and of great influence upon the bodily and temporal welfare of man. The order is difficult to study for the very reason that so few have devoted their attention thereto, but it affords scope for much original work, which cannot fail to be of great importance. There are probably hundreds of species now in the collections of our members waiting for some student to make them known to us.

The neuroptera and pseudoneuroptera are less rich in species, but include some of our largest and most striking insects, such as the dragon-flies.

"To-day I saw the dragon-fly
Come from the wells where he did lie.

An inner impulse rent the veil
Of his old husk; from head to tail
Came out clear plates of sapphire mail.

He dried his wings; like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew."
—*Tennyson.*

The early stages of many forms can be advantageously studied in aquaria, for the life histories of but few of the American species have been published. Here is another inviting and almost unoccupied field for students seeking a special line of work.

The same may be said of the orthoptera, our species of which are not numerous, but of moderate size and frequently present in great abundance. They are among the most destructive insect enemies of plant life, but atone, in some measure, for their ravages, by the animation of their movements, and their almost ceaseless stridulation breaking agreeably the silence of the fields.

> " In intervals of dreams I hear
> The cricket from the droughty ground ;
> The grasshoppers spin into mine ear
> A small innumerable sound."
> —*Lampman.*

The hemiptera consist of two very large and important groups, which contain many species exceedingly injurious to the crops which man raises, with so much labor, for his sustenance, and even from merely material motives the "bugs" are deserving of careful study. Nor are these insects all unattractive in their forms and habits ; many of them, in fact, are very prettily ornamented. It is fully time that some attention was bestowed upon them by our members.

Even yet the avenues of study have not been exhausted ; when all the six-footed insects have been examined there still remain for observation the spiders, skilful weavers of the silken films that glisten in the morning dew ; the mites, so small and yet so grievously afflicting man and beast and plant ; with other allied arthropods of considerable variety of form and habit, which fall within the scope of entomological research.

The volumes of the *Canadian Entomologist* contain many important papers by our numerous and hard-working entomological friends in the United States, upon the orders and groups which have been so much neglected by our own correspondents. These papers indicate the interest and value which is attached to their study, and in these contributions it is often observed that the species under discussion have been derived from Canadian sources. This indicates that our collectors are not working up the material that they obtain with so much care and patient searching. It is certainly easier to send specimens to specialists abroad than it is to determine them with the scanty library and cabinet resources at the command of most of us. But one should not rest satisfied merely with such determinations, but by subsequent study of his insects increase his knowledge regarding them. He will thus be able, at least, to publish correct local lists which may be of great value in the more complete study of the fauna of larger regions, and as data for establishing the distribution of species.

There is a great temptation to amass large collections, which in themselves are very desirable and important, but whose care and incident correspondence and exchange may so engross one's time that profitable lines of investigation are neglected, and one becomes merely an insect curator instead of an entomologist. The finest collection may be suddenly destroyed or its possessor incapacitated for further labor, and the knowledge which he has accumulated by many years of patient toil is then lost to science, if it has not been published. There are rare instances of writers who seem unable to restrain themselves from any topic, but the majority of entomologists doubtless find, as I do myself, that it is far more pleasant to collect, examine and arrange their specimens than to sit down and write about them. Yet we should try to do our duty in this respect also, knowing that, if we have made discoveries or valuable observations, we owe it to our fellow-workers to make them participants therein through the pages of the *Canadian Entomologist.*

If gentlemen, you have found my paper dry, I may but hope that it has been dry enough to kindle fresh entomological fires, or add fuel to those already existing ; fires that shall emit not merely flashes of passing enthusiasm. but which shall burn brightly and steadily, casting light where the shadows now deepen, and by genial warmth stimulating to renewed attack upon the myriad problems which await your solution in the almost limitless and ever-attractive domain of Insect Life.

Appendix A.—List of Fifty Contributors, with the Number of Volumes to which they Contributed

	No.
Bean, Thos. E., Laggan	2
Bell, Prof. J. J., Belleville	2
Bell, J. T., "	4
Bethune, A. M., Port Hope	1
Bethune, Rev. C. J. S., Port Hope	22
Billings B., Ottawa	1
Bowles, G J., Quebec, Montreal	12
Brodie, W., Toronto	5
Caulfield, F. B., Montreal	14
Clementi. Rev. V., North Douro	4
Couper, W., Montreal	9
Cowdry, N. H., Stratford	1
Croft, Prof. H., Toronto	2
Danby, W H., Victoria	2
Dawson, Percy M., Montreal	1
Denton, J. M., London	1
Evans, J. D., Trenton	1
Fletcher, J., Ottawa	13
Fyles, T. W., S. Quebec	12
Geddes, Gamble. Toronto	7
Gibb, Lachlan, Montreal	1
Gott, B., Arkona	1
Guignard, J. A., Ottawa	2
Hanham, A. W., Hamilton	2
Harrington, W. H., Ottawa	14
Hausen, I. F., Montreal	2
Heustis, Mrs. Caroline E., St. John, N.B.	5
Jack, John G., Chateaugay Basin	5
Johnston, James, Hamilton	1
Jones, J. Matthew, Halifax	1
Keen, Rev. J. H., Masset, B.C	1
Kilman, A. H., Ridgeway	3
Lyman, H. H., Montreal	12
Macoun. John, Belleville	1
Moffat, J. Alston, Hamilton	16
Murray, Wm., "	3
Norman, Geo., St. Catharines	2
Pearson. C. W., Montreal	3
Pettit, J., Grimsby	5
Provancher, Abbe, Cap Rouge	2
Reed, E. Baynes, London	13
Rogers, R. V., Kingston	5
Saunders, H. S., London	1
" Prof. W., "	19
" W. E., "	2
Taylor, Rev. G. W., Victoria	4
White J., Edmonton, Ont	1
Williams, J., London	1
Winn, A. F., Montreal	2
Wintle, Ernest D., Montreal	1

Appendix B.—List of Contributions (not Complete) by the Writers Mentioned in Appendix A.

Lepidoptera.

	Vol.
Entomological Notes (a series of papers), Saunders	I.
Notes on Canadian Lepidoptera (a series of papers), Bethune	I.
List of Diurnal Lepidoptera observed in the neighborhood of Ottawa, during the season of 1868, Billings	I.
Larva infesting the Parsnip (*Depressaria Ontariella* n. sp), Bethune	II.
On a supposed new Arctian, Saunders	II.
Description of larva of Catocala Polygama. Guen., Reed	II.
Notes on Hadena Xylinoides, Saunders	II.
On the larva of Thecla inorata, G. R. Saunders	II.
A new species of Anarta, Bethune	II.
Note on Amphipyra Tragoponis, Bethune	II.
On the larvæ of some Lepidoptera, Saunders	II.
List of Lepidoptera taken at Quebec, Bowles	II.
Accentuated list of Canadian Lepidoptera, Reed	II.
On Neonympha Eurythris, Fab , Saunders	II.
Notes on Lepidopterous Larvæ (series of papers) Saunders	III.
Notes on Samia Columbia, Bowles	III.
Lepidoptera of Anticosti and North Shore of the St. Lawrence, Couper	IV.
Captures of Noctuidæ at St. Catharines, Ont., Norman	VII.
List of Diurnal Lepidoptera of the Island of Montreal, Caulfield	VII.

List of Sphingidæ and Zygænidæ occurring on the Island of Montreal, Caulfield.	VII.
Captures of Noctuidæ near Orillia, Norman	VIII.
List of Bombycidæ occurring on Island of Montreal, Caulfield and Pearson	IX.
Sphinx Eremitis, Fyles	XI.
Observations on Limenitis Arthemis, Mrs. Heustis	XV.
List of Geometridæ taken at Quebec and Montreal, Bowles	XV.
List of Diurnal Lepidoptera collected in the Northwest Territories and the Rocky Mountains, Geddes	XV.
Notes on Colias Christina, Lyman	XVI.
Thecla Niphon, Fletcher	XVI.
Remarks on the Family Bombycidæ, Bowles	XVI.
Rocky Mountain Butterflies, Geddes	XVII.
Additions to the list of Canadian Lepidoptera (a series of papers), Moffat	XVIII.
Additions to the list of Montreal Lepidoptera, Bowles	XIX.
The North American Callimorphas (with plate), Lyman	XIX.
Notes on the Genus Argynnis while alive in the Imago state, Geddes	XIX.
Notes on the Genus Colias, Lyman	XX.
Description of the preparatory stages of Chionobas Jutta, Fyles	XX.
Notes for collectors visiting the Prairies and Rocky Mountains, Geddes	XXI.
Notes on the preparatory stages of Carterocephalus Mandan, Fletcher	XXI.
The N. Am. Callimorphas—a reply to critics, Lyman	XXI.
The Mediterranean Flour Moth, Fletcher	XXII.
The Butterflies of Laggan, N. W. T., account of certain species inhabiting the Rocky Mountains in lat. 51°, 25′, Bean	XXII.
Food plant of Melitæa Taylori, Edw. Danby	XXII.
Notes on Argynnis Freya, Chariclea and Montinus, Lyman	XXII.
Gelechia Gallædiplopappi, n. sp., Fyles	XXII.
Note on the occurrence of Lepisesia Flavofasciata, Barnston, Lyman	XXIII.
List of Lepidoptera taken at Little Metis, Que., Winn	XXIII.
Hybernia Defoliaria, Linn. in Vancouver Island, Taylor	XXIII.
Some rare Lepidoptera taken near Montreal, Winn	XXIII.
Vanessa Californica in Vancouver Island, Danby	XXIII.
Pamphila Manitoba, Scud., and its varieties, Lyman	XXIV.
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Coleoptera taken in the neighborhood of London, Ont., during the season of 1868, Reed	I.
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Additions to Canadian lists of Coleoptera, Harrington	XVI.
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Coleoptera at the electric light, H. S. Saunders	XIX.
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On the lists on Coleoptera published by the Geological Survey of Canada, 1842-1888, Harrington	XXII.
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Some British Columbia Coleoptera, Keen	XXIII.
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Remarks on the History and Architecture of the Wood Paper-making Wasps, Couper	II.
Notes on the Humble Bees, Bowles	XI.
The Entomology of Vancouver Island. Notes on 80 species of Hymenoptera collected near Victoria, V. I., in 1882, Taylor	XVI.
A new Tenthredinid, Provancher	XVII.
Notes on the occurrence of some species of Uroceridæ, Harrington	XVII.
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Oryssus Sayi, Harrington	XIX.
The Nuptials of Thalessa, Harrington	XIX.
New species of Canadian Tenthredinidæ, Harrington	XXI.
Ibalia maculipennis, Haldeman, Harrington	XXI.
Tenthredinidæ collected at Ottawa, 1889, Harrington	XXII.
Nematus pallidiventris, Fallen—a fresh importation, Fyles	XXIII.
Two new species of Canadian Pimplinæ, Harrington	XXIII.
Canadian Galls and their occupants, Brodie	XXIV.
Notes on Zarea Americana, Fyles	XXIV.
Canadian Hymenoptera (series of papers), Harrington	XXIV.
Typhon flavifrons, n. sp., Fyles	XXV.

Diptera, Hemiptera, Neuroptera and Orthoptera.

	Vol.
List of Neuroptera (collected at Grimsby), Pettit	VI.
List of Canadian Diptera (compiled from Brit. Mus. Catalogue), Couper	IX.
Description of a dipterous parasite of *Phylloxera vastatrix*, Fyles	XIV.
List of Diptera taken in the vicinity of Montreal, Que., Caulfield	XVI.
Notes on Ceresa bubalus, Jack	XVIII.
Notes on Ant-lions, Moffat	XVIII.
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General Papers.

	Vol.
Entomological notes during a trip to the Saguenay, Saunders	I.
Insects of the northern parts of British America compiled from Kirby's Fauna Boreali Americana, Bethune	II.
Quebec Currant Worms, Bowles	III.
Entomological notes during a trip to Lakes Huron and Superior, Bethune	III.
Hints to Fruit Growers (series of papers), Saunders	III.
On some of our Common Insects (a series of papers by Saunders, Bethune, Geddes, Rogers, etc., commenced)	V.
Entomology for Beginners (a series of papers by Saunders, Bethune, Fletcher, Harrington, etc., commenced)	XI.
Entomological notes, Jack	XVII.

A vote of thanks to Mr. Harrington for his valuable and very interesting address was moved by the Rev. Dr. Bethune, who remarked in doing so that he hoped all the members of the Society would be stimulated by the historical record their President had given them to fresh efforts in their investigations and renewed zeal in contributing their observations to the *Canadian Entomologist* and the Annual Report. Mr. Fletcher, in seconding the motion, gave an account of the admirable work that Mr. Harrington has been doing for many years past in collecting and studying the coleoptera and hymenoptera of Ottawa and its neighborhood ; in the latter order especially he had accomplished very much, and described a number of new species. The motion was very cordially received by the meeting, and the vote of thanks was accorded with much acclamation.

The reports of the different sections of the Society were then presented and read by their respective Secretaries.

The Treasurer, J. A. Balkwill, read the following report of Receipts and Expenditure for the year ending August 31st, 1894 :

REPORT OF THE TREASURER.

RECEIPTS, 1893-4.		EXPENDITURE, 1893-4.	
Balance on hand Sept. 1st, 1893	$ 457 54	Printing	$ 631 33
Members' fees	291 08	Report and meeting expenses	157 70
Sales of Entomologist	73 90	Library	82 05
" pins, cork, etc.	62 79	Expense, postage, etc.	116 82
" duplicates	5 25	Rent and fuel	159 97
Government grant	1,000 00	Insurance	28 00
Advertisements	13 50	Salaries	350 00
Interest	14 24	Pins, cork, etc	31 83
		Balance on hand Aug. 31st, 1894.	360 60
Total	$1,918 30	Total	$1,918 30

We, the Auditors of the Entomological Society of Ontario, certify that we have examined the books of the Treasurer, compared them with vouchers, and find them correct, and that the above is a true statement.

JOHN M. DENTON, } Auditors.
JAS. H. BOWMAN, }

REPORT OF THE MONTREAL BRANCH

Mr. H. H. Lyman read the following report.

Annual Meeting of the Montreal Branch of the Entomological Society of Ontario:

The 21st annual meeting of the Montreal Branch was held at the residence of Mr. H. H. Lyman, 74 McTavish street, on Tuesday evening, May 8th, at 8 o'clock.

Members present, Messrs. H. H. Lyman, President ; J. F. Hausen, W. C. Adams, A. F. Winn. Rev. E. C. Trenholme, a former member was also present.

The President presented the following report of the Council :

21st Annual Report.

The Council beg to present the following report for the year 1893-94 :

From a variety of causes we have had less meetings than usual during the past winter, but the four that were held were well attended, and the following papers have been read :

I.—Common names for butterflies. Shall we have them ? H. H. Lyman.

II.—A Trip to Gomin Swamp, Quebec. H. H. Lyman.

III.—Trypeta solidaginis and its parasites. Rev. T. W. Fyles.

One new member has been added to our roll, Mr. O. C. Hart, but the resignation of Mr. H. B. Cushing has lost us one.

The Council would urge the members to contribute more papers at the meetings, giving accounts of some of their collecting trips, or experience in raising species from the egg or larva as well as to bring more specimens with them.

The present season has opened unusually early, and there seems to be a prospect o a particularly good year for insects, and it is hoped that a lot of good work will be don by our entomologists.

The Treasurer's report showed the balance at our credit to be growing slowly.

Respectfully submitted on behalf of the Council.

(Signed), H. H. LYMAN,
President.

The following officers were elected for the ensuing year :

President—H. H. LYMAN.

Vice-President—LACHLAN GIBB.

Secretary-Treasurer—W. C. ADAM.

Council—J. F. HAUSEN, A. F. WINN.

Mr. Winn read a paper entitled " An Hour at Hochelaga," illustrated by the specimens taken.

The meeting then adjourned.

A. F. WINN,
Secretary.

REPORT OF THE GEOLOGICAL SECTION.

Mr. President and Members :

I regret that the chairman of our section for the past year is not with us to-night. I refer to the Rev. Chas. Andras, who, you will remember, was with us a year ago at our last annual meeting, but has now gone to reside in the North West. We expected with his assistance to have presented a full and comprehensive report of the proceedings of our Society for the past season. We have had no more active member in our section than he since its organization. All his spare moments were devoted to making a collection of the minerals and fossils of this region, most of which were exhibited to the class from time to time, adding very much to the interest as well as profit, and giving us some idea of what might be obtained at our own doors. He made a very large private collection during the time he was with us. Together we visited most of the outlying towns in search of specimens for our cabinets, and have travelled on foot many a mile in these holiday outings.

Among other places we have visited St. Marys, Dorchester, Kilworth, Byron, Komoka, Kettle Point (Lake Huron), Ilderton, Thedford, Beachville and Woodstock.

Occasionally we had some of our fellow workers to bear us company and assist in our undertakings and researches.

I can only mention a few of my observations along the geological line. The work undertaken by this section has been greater and more successful than in any previous year, not only as regards the material that has been collected, but also in the interest the members have shown by regular attendance at our weekly meetings, and taking an active part in the discussions that have arisen from the objects laid before them.

We have also been favored with several interesting lectures and papers on various geological subjects as follows :

By the Rev. Prof. Andras :

I.—Earthquakes.

II.—Talk on British Coal Fields.

III.—Sketches of his North West Travels.

By Prof. J. H. Andras :

I.—Papers on Cephalapoda.

II.— " " Arcidae.

By Dr. I. G. Wilson :

I.—Paper on Silica.

II.— " " Glacial Drift.

By Mr. I. Goodburn :

I.—Lecture on the Six Days' Work of Creation.

By. S. Woolverton :

I.—Paper on Trilobites.

It is proposed to print some of them for circulation, or if thought worthy in the Journal of this society. Several of these addresses were given at the home of the vice-chairman, where an available collection is to be found, the better to illustrate the subject of the lecture.

Another observation perhaps worthy of mention, is the finding of a great number of Indian relics in this vicinity during the past summer. A number of mounds have been dug over and many rare specimens have been obtained of the North American Indian, notably—skinning-stones, pipes, bone needles, bones of the animals eaten by early inhabitants, in a perfect state of preservation, with pottery in great abundance.

The remains were all found in ash heaps, kitchen middens so called, showing conclusively that this was once a favorite resort and hunting-ground of a race of people that have faded away over three hundred years ago.

From this source sufficient material has already been collected to stock a department in a public museum.

S. Woolverton,
Vice-Chairman.

REPORT OF THE BOTANICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

The Botanical Section beg to offer the following report for the summer of 1894.

The first meeting was held on April 21st, and from that date until September 24th regular meetings were held, except for a part of August.

At all the meetings the attendance has been fair, and a number of young business and professional men have become enthusiastic workers. The principal work undertaken was the collection, identification and recording of the phaenogamous plants of this district.

Field days in various directions were very fruitful, especially to Komoka on May 24th, when 77 species of plants were identified, all in bloom. At Mud Lake, south of Dorchester station, the beautiful and extremely sweet scented *Habenaria blephariglottis* was found abundant on July 2nd.

Probably the most important collections of the season were : *Collinsia verna*, taken by Mr. Robert Elliott near Plover Mills, London township, Middlesex, May 26th, now first recorded in Canada ; and *Utricularia resupinata*, collected by Mr. J. H. Bowman, near Bala, Muskoka, not before identified and recorded to our knowledge.

A specimen of the notorious Russian Thistle was found by Mr. Dearness, near Tilbury Centre in Kent county.

All of which is respectfully submitted.

W. F. McClement,
Secretary.

REPORT FROM THE ENTOMOLOGICAL SOCIETY TO THE ROYAL SOCIETY OF CANADA.

By Rev. Thomas W. Fyles, F. L. S., Delegate.

I have the honor to report that the Entomological Society of Ontario continues, with zeal and success, its researches into all such subjects as naturally fall under, or in any way have a bearing upon Scientific and Economic Entomology.

The membership of the Society during the past year has greatly increased, especially by additions from the Province of Ontario. This fact betokens both a growing interest in the subject of entomology, and also an increasing confidence in the Society as a guide and helper in its pursuit.

The Society was established in 1863. Of its founders but few now remain; most of them have been lost to us through death, or departure to distant places of residence. By the members of the present day their memory is held in grateful respect. The Society, however, still enjoys the benefit of the experience and scholarship of the Rev. C. J. S. Bethune, and the business talent of Mr. J. M. Denton. The names of these gentlemen appeared in the first list of officers published by the Society, and they are found also in the list published for the present year.

The Society enjoys the confidence of the many able entomologists who have been appointed to positions in the colleges and experimental stations of the United States of America; and numerous articles from these gentlemen have appeared in the Society's publications. It also numbers among its correspondents leading entomologists in England and Germany.

It is largely due to the wise and liberal support of the Ontario Government that the Society has been enabled to attain its present eminent position of usefulness.

The report of Mr. J. A. Balkwill, Treasurer of the Society, shows that its finances are in a highly satisfactory state—all expenses having been met, important purchases for increasing the advantages of the Society having been made, and a sufficient balance remaining for carrying on the immediate work of the Society.

Seventy volumes have been added to the Society's library in the course of the year, by donation and purchase. Among them are: the "Tenth Volume of the Proceedings and Transactions of the Royal Society of Canada," "The Report of the Ontario Game and Fish Commission," "The Report of the Smithsonian Institution," "The Report of the New York State Museum," "The Mammals of Minnesota," "The Hawks and Owls of the United States," "The Seventeenth Report of the Geology and Natural History of Indiana." The number of books in the library is now 1,284. Very important additions have also been made to the Society's collections of natural objects.

Valuable work has been done by the Ornithological, the Botanical, the Microscopical and the Geological Sections of the Society, and a report from each of them was read at the annual meeting. With a view to bringing the knowledge and experience of the members of these sections to bear more frequently for the good of the Society at large, a Committee on Field Days, consisting of Dr. Woolverton, Messrs. McClement, Elliott and Stevenson, and one representative from each section, was appointed at the annual meeting.

The Montreal Branch of the Society held eight meetings during the year, at which interesting papers were read, and much profitable conversation upon entomological subjects generally was held. The branch numbers among its members men well acquainted with the entomology of the Montreal Island: Messrs. L. Gibb, A. F. Winn, F. Hausen and H. B. Cushing; and the hospitality of Mr. H. H. Lyman, the president of the branch, and the access he has afforded to his extensive collections of lepidoptera have made the meetings of the branch exceedingly pleasant and profitable.

The Annual Report of the Society, printed by order of the Legislative Assembly of Ontario, contains: a record of the proceedings of the annual meeting held October 11th and 12th; reports from the council and the various officers and sections of the Society; the opening address of Mr. James Fletcher (given in the absence of the president), and telling of the injurious insects of the year and the various modes of dealing with them; and the annual address of the president, Mr. W. Hague Harrington, likewise containing much valuable information on these subjects. These are followed by contributions from members of the Society, viz.:

"The Entomological Mistakes of Authors," by Rev. Thomas W. Fyles, South Quebec.
"The Season of 1893," by the same.
"Mosquitoes," by J. Alston Moffatt, London, Ont.
"Canadian Uroceridæ," by W. Hague Harrington, Ottawa.
"Additional Notes on Japanese Insects," by the same.
"Notes and Queries," by Rev. W. J. Holland, Ph.D., Allegheny, Pa.
"The Dragon Fly," by T. J. MacLaughlin, Ottawa.
"The Song of Thyreonotus," by William T. Davis, Staten Island, N.Y.
"Notes on some of the more important Entomological Exhibits at the Chicago Exhibition," by James Fletcher, Ottawa.

Then comes a full report of the annual meeting of the Association of Economic Entomologists, furnished by Mr. L. O. Howard, of the Division of Entomology, Department of Agriculture, Washington, D.C., together with some of the most generally interesting papers read at the meeting. Some of these are by the most eminent and practical entomologists of the United States, and all of them are valuable. The closing pages of the report are devoted to book notices, obituaries, etc.

The *Canadian Entomologist*, the Society's monthly organ, completed at the end of the year its 25th volume. This volume contains descriptions of no less than 162 new species of insects. The contributors to its pages number 56. Among them are men of world-wide reputation.

That the Society may be of service to the community at large, by teaching our farmers, gardeners and fruit growers the life histories of their insect friends and insect foes, and by showing them how the injurious attacks of the latter are carried on, and what steps should be taken to meet and nullify them is, we believe, the earnest desire of every one of its numerous members.

Appended will be found a list of the officers of the Society.

The whole is respectfully submitted.

THOMAS W. FYLES, F.L.S., Delegate.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year:

President—W. HAGUE HARRINGTON, F.R.S.C., Ottawa.
Vice-President—J. DEARNESS, London.
Secretary—W. E. SAUNDERS, London.
Treasurer—J. A. BALKWILL, London.
Directors—Division 1, JAMES FLETCHER, F.L.S., F.R.S.C., Ottawa.
Division 2, REV. C. J. S. BETHUNE, F.R.S.C., Port Hope.
Division 3, GAMBLE GEDDES, Toronto.
Division 4, A. H. KILMAN, Ridgeway.
Division 5, R. W. RENNIE, London.
Librarian and Curator—J. ALSTON MOFFAT, London.
Editor of the "Canadian Entomologist"—REV. C. J. S. BETHUNE, M.A., D.C.L., Port Hope.

Editing Committee—J. **Fletcher**, Ottawa ; H. H. **Lyman**, Montreal ; **Rev.** T. W **Fyles**, South Quebec ; J. M. **Denton** and J. H. **Bowman**, London.

Delegate to the Royal Society—**Rev.** T. W. **Fyles**, South Quebec.

Committee on Field Days—**Dr. Woolverton**, Messrs. **McClement**, **Elliott** an **Stevenson**, London.

Auditors—J. H. **Bowman** and J. M. **Denton**, London.

Dr. Woolverton exhibited a very perfect and beautiful trilobite, *Phacops bufo*, from the Devonian rocks in the neighborhood, and made some interesting remarks upon the geology of the district.

Mr. Bowman made a verbal report upon the proceedings of the Microscopical Section during the past season.

Mr. W. Scarrow suggested that the Council should be instructed to find more suitable quarters for the Society, as the present room was entirely inadequate for the purpose The matter was discussed at some length by several of the members, and it was finally decided that the officers of the Society resident in London should be empowered to look for satisfactory accommodation, and take whatever steps might be necessary to secure it

A very entertaining and interesting paper was then read by the Rev. T. W. Fyles on "Food, Feeders and Fed," which was highly appreciated by the audience.

The meeting adjourned at 10.30 p.m.

THURSDAY, NOVEMBER 8TH.

MORNING SESSION.

The meeting was called to order by the President at 10 o'clock a.m.

The first paper read was by Mr. H. A. Stevenson describing an attack by the moth, *Ephestia interpunctella*, in a warehouse in London, and the successful manner in which it had been dealt with.

Dr. Bethune then read an interesting paper on "The Economic Value of Parasitism," by Prof. F. M. Webster, of Wooster, Ohio. Mr. Harrington, in commenting on the paper, stated that the canker worms which had been so injuriously abundant about Ottawa for two or three years, were this season almost exterminated by their parasites

Mr. Moffat presented papers on "A re-appearance of Pieris Protodice," and "Remarks on the Structure of the Undeveloped Wings of the Saturniadæ."

A paper by Prof. L R. Jones, of the Agricultural Experiment Station at Burlington Vermont, on "Bordeaux Mixture as a Deterrent Against Flea-beetles," was presented by Mr. Fletcher.

[All the papers read at the different sessions are printed *in extenso* in the following pages of this Report.]

Resolutions regarding the binding of periodicals and the case of members in arrears with their subscriptions, were brought forward and discussed, and action taken upon them

The remainder of the morning was spent in examining and determining specimens which had been brought to the meeting by various members. At twelve o'clock the proceedings were brought to a close, all who had taken part in them having much enjoyed their annual gathering and the many interesting papers brought before them.

INSECTS COLLECTED IN BERMUDA DURING THE WINTER OF 1894.

BY GAMBLE GEDDES, TORONTO.

The paper I propose to read before the members of the Society, will not, I fear, treat especially upon insects, for I have experienced great difficulty in securing the names of many of the species captured by me in Bermuda during the four months of last winter beginning in January. I can, however, place a number of examples before you for inspection, which may prove interesting in that they correspond so closely to many of our Canadian insects.

I shall, in the course of the paper, touch upon a few of the food-plants which came under my notice and read a list of the insects named in the only book that I could find on the subject in the Public Library. This list will not, I can assure you, occupy much of your time, as it was published thirty years ago, and very little collecting has been done since.

In considering the diurnal lepidoptera of the Islands, I shall begin first with *Danais Archippus*, which species was flying about freely in February and March. I fancy it must be an all-the-year-round insect as I took eggs and larvæ upon a lovely asclepias (*A. Curassavica*) at the same time that I captured apparently perfect imagos.

Of this asclepias I have raised from seed several healthy plants, and was in hopes that I could produce one in bloom.

Mr Oswald A. Reade, (now a pharmaceutical chemist in London, England), has made his mark as a botanist in Bermuda and elsewhere, and has written a book entitled, "Plants of Bermuda, or Somer's Islands."

In his description of this asclepias (or Butterfly weed) he states that it is a perennial plant, growing from two to four feet high, half shrubby at the base, the stems being cylindrical and downy. The pods are ovate, smooth and seeds embedded in glossy, silky hairs. Distribution, West Indies. Habitat, waste places. He also says flowers showy, scarlet and orange, frequent, July to November.

I presume when he states those particular months he means that these plants are in their "prime" at this time of the year, for I found full grown larvæ, and also, very diminutive larvæ, also eggs, upon asclepias during the months of February and March.

I did not find any of the larvæ on the other asclepias, viz., *A. Linaria.*

The commonest and only other diurnal I captured was *Junonia Cœnia*, and the larvæ of this insect fed freely upon the leaves of the common sage bush, (*Lantana Odorata.*) This shrub forms the principal undergrowth of all the Islands from one end to the other of the group. It has been grown to great perfection in many of our hothouses.

J. Cœnia in its flight reminds me very much of the Vanessidæ and is quite difficult to catch on a sunny day, but easy to net in damp and foggy weather.

These two species are the only ones taken in winter, but a list was printed in "The Naturalist in Bermuda," by Jno. Matthew Jones and Major Wedderburn, (late 42nd Highlanders) and J. L. Hurdis. Esq., in 1863—thirty-one years ago—which reads as follows :

Danais Archippus	Food plant, asclepias, common.	
do. Berenice	do.	rare.
Vanessa Atalanta	April to November.	
Cynthia Cardui	Early November, abundant 1852.	
Vanessa Antiopa	Rare.	
Junonia Cœnia	Called Musk Butterfly, common.	
Terias Lisa	September, October and November.	
Unknown (1853, September)	Brimstone yellow, tinged with a greenish hue large as English Brimstone Butterfly, taken on potato patches.	

These eight varieties of butterflies appear to be all known at that time whilst none of the Skippers or Lycænidæ appear to have been captured. This seems a curious fact as it is well known that both families are abundantly represented in the southern States and in all the West Indian Islands.

Sphinx (*Phlegethontius*) *Cingulata* is very common in season, the larva is taken on the Papaw (*Asiminia Triloba*) has a thick caudal horn and pupates in the ground as most of the Sphingidæ do. (See Grote's check list of the Hawk moths of North America.)

The other Sphinx taken by myself was *Chærocampa* (*Deilonche*, Grote) *Tersa*. Larva feeds on Button-weed (*Spermacoce Glabra.*) Mr. Grote, in his remarks upon this insect says, rare in Canada and Eastern States, more common in the south ; it has at least two congeners : *Deilonche Robinsonii* (Grote) in Cuba, and *D. Falco* (Walker) in Mexico ; comparative studies must be made with other forms referred by Butler to Chærocampa, a genus with European types.

I was also informed in Bermuda that *D. Lineata* had been taken, but I saw no traces of it in the few collections I came across, nor did I take a specimen myself.

I now come to the most interesting part of the collection I made, viz.: the various families of moths outside of the Sphingidæ. I am indebted to Mr. Moffat for his kindness in naming a few that are identical with the Canadian species. I was unfortunate in not meeting Mr. Neumogen, of New York, on my way back, as in these matters he has always been most willing to assist me.

I am not aware of seeing any specimens in the following families, viz.· Ægeriadæ, Thyridæ, Zygænidæ, Bombycidæ; but of Noctuidæ, Geometridæ, Pyralidæ and Tortridicæ there is evidently a large field open for collectors even in the winter months. In the Noctuidae the Drasterias and Plusias largely predominate and the undetermined species which I have with me will clearly indicate what a wealth of them exists on these islands.

I shall endeavor to get a correct list of all the Noctuids, as well as the other groups, and give a list of those which have occurred in Canada, that are identical with the Bermudian insects. This list I should be pleased to have published in the " Entomologist " for future reference by those who may be interested.

In Pyralidæ I have taken in numbers, ***Eudioptis hyalinata*** of Linneus, *Nomophila noctuella*, ***Botis adipaloides*** and many others not yet identified.

The majority of these moths have been taken in the bright sunshine, mostly during the time of day known in Bermuda as " between the showers " and rarely at dusk.

The favorite flower of the Plusias was *Sinapis nigra* in appearance like a white mustard flower ; also a species of Golden Rod, (*Solidago sempervirens.*)

I have also taken a number of Pyralidæ on the common "Sowthistle," (*Sonchus Oloraceus*) and a few Coleoptera on the same plant.

A few of the micros appeared to gather their food from a beautiful little plant resembling a dicentra, viz.: *Fumaria Densiflora* ; and *Parthenium Hysterophorus*, a bunch aster, was full of all kinds of insects.

Upon the vetch (*Vicia Saliva* I think) I took numerous Hymenoptera, notably the Bermuda wasp, *Polistes pallipes.*

Upon the flower of the orange Lantana, (*L. Crocea*,) most of the Diptera were caught, and this lovely shrub grows everywhere, so freely that one was seldom at a loss to look for a bush of it.

Coleoptera. Very few Coleoptera are known in Bermuda, as far as I can ascertain, my total catch for over three months being 15 specimens—6 of which evidently are one species taken from the centre of full-blown roses.

Of Diptera I took about 50 specimens, including our own pet housefly. This was by no means uncommon during winter as the domestics had to drive them out of the rooms two or three times a day in fine weather and keep the house quite dark. Another favorite, (the musquito,) was only too common, and for variety in size and the nature of its bite, I consider them unequalled. These unwelcome intruders kept me so continually busy in looking after my own interests that I came to the conclusion I would not study their food plants—nor would I recommend them to any of my Bermudian friends as a "benefical insect" (to mankind at least.)

Of Hemiptera about 6 varieties were captured, principally about the Loquat tree and upon the tree known as The Pride of India.

The Loquat is a favorite fruit with not only the natives but nearly every visitor who tastes it. The botanical name is *Cydonia Japonica*, and as its name implies is a native of Japan, and thrives in sheltered places.

The Pride of India, (*Melia Azedarach*) is a grand tree and lines the boulevards of the principal streets in Hamilton. I have water-color sketches of these trees, one in fruit the other in flower.

There is one other fruit tree the product of which seems most palatable to the natives, viz.: The Surinam Cherry. I am at fault about the scientific name, but also produce a water-color sketch of the fruit at its best. Upon the blossoms the Plusiadæ and bees are to be taken, frequently in February and March. I have no doubt in the summer months the second crop would attract many more examples, for the trees fruit twice a year, I have been told by old residents.

Referring to this tree I have taken a few katydids and grasshoppers, (Orthoptera,) amongst them doubtless *Conocephalus Ensiger*, although I must confess I prefer the song of his green colored cousin *Phylloptera Oblongifolia*, hailing from our midst and which is found drowned so often on the shores of our lakes in Upper Canada after a heavy gale of wind.

The spiders would give entertainment to any enthusiast for months, for their name is legion.

In conclusion I may add that the Neuroptera were very scarce during the wintertime, although I saw several varieties in some of the local collections which were unnamed. Evidently they were abundant about the marshes during the summer months.

COMMON NAMES FOR BUTTERFLIES.—SHALL WE HAVE THEM?

By H. H. Lyman, Montreal.

Read before the Montreal Branch 14th November, 1893.

This is a question upon which the entomologists of this continent have been as much divided as upon any of the deeper scientific problems which have engaged their attention.

The great majority of the working entomologists have been strongly opposed to their introduction, some even fiercely so, but there have been a few entomologists, some of them of the first rank, who have espoused their cause with at least some measure of success.

Of course there are many objections to these names, the chief being their purely arbitrary and unscientific application, the impossibility of securing uniformity in their use and the difficulty of obtaining suitable and sufficiently concise names for more than a very limited fauna

The opponents of popular names assert that it should be as easy to remember the scientific as the common names and that if it is not, we should not encourage laziness by adopting them.

I used to be as strongly opposed to these names as anyone but latterly have sometimes thought that if their adoption would result in popularizing the study of this science the gain would be worth the sacrifice.

In this paper, therefore, I propose to discuss this subject which has recently been brought again into view by Mrs. Slosson's interesting paper in the first number of the journal of the New York Entomological Society, and shall try to do so in a calm and judicial manner. Of course Mrs. Slosson would not suggest that the names which commend themselves to her proteges should be generally adopted, but why should we not have common names scientifically applied?

It is all very well to say that it should be as easy to remember the scientific as the popular name, but it isn't. It ought to be, of course, just as it ought to be just as easy for children to be good as to be naughty.

I have often been asked the name of a moth and when I had given it, it has been greeted with a laugh of derision, for the general public scoff at these scientific names, and one doesn't wonder when one looks over a catalogue and sees the terrible names, such as nezahualcoyotl, which have been given to beautiful and inoffensive creatures.

It does not degrade Botany to have the Cypripedium called the Lady's Slipper, the Ranunculus the Buttercup, or Lonicera the Honeysuckle, nor does Ornithology suffer because Hirundo Horreorum is better known as the Barn Swallow, and Tyrannus Carolinensis as the Kingbird, and why should there be an outcry at calling the lovely Idalia the Regal Fritillary, or Grapta Gracilis the Hoary Comma?

I believe that if we could have common names for our butterflies and a cheap, but good, book with a recognizable colored illustration of each species, such as England has in Coleman's British Butterflies, we should have at least ten persons interested in entomology for every one that we have to day.

If it be urged that it is impossible to secure absolute uniformity in the use of these names the same is true of the scientific names, as we all have to remember in reading Mr. Scudder's works that what he calls Jasoniades Glaucus is what the rest of us call Papilio Turnus.

It seems to me that one of the chief objections to the adoption of these popular names is their arbitrary application totally regardless of scientific relationship. For instance, they have in England two butterflies, known respectively as the White Admiral and the Red Admiral. Naturally one would suppose that these belonged to the same genus, instead of which they belong to entirely distinct genera, which in Kirby's world-wide catalogue are separated by fifty-seven other genera, while on the other hand the nearest ally in England of the Red Admiral is called the Painted Lady, which is surely an opprobrious name.

When I began collecting as a child, upwards of thirty years ago, and wanted to know the names of my treasures, I was told that Cardui was the Thistle butterfly. Shortly afterwards I captured a specimen of Atalanta, and fairly gloating over the pre-eminent beauty of its under surface I named it the Queen Thistle, for child though I was, I at once recognized its close relationship to the other. But in the common names which have been proposed by various authors, the generic relationship has frequently been lost sight of. A very marked example of this occurs among Scudder's names in two cases adopted from Gosse, for some of the Pierinæ: thus Eubule is the Cloudless Sulphur; Philodice is the Clouded Sulphur; Lisa is the Little Sulphur. Then in the genus Argynnis, Atlantis is the Mountain Silver Spot while Aphrodite is the Silver Spot Fritillary, the latter certainly a most indefinite name considering the number of silver spot fritillaries we have on this continent. On the other hand some of Gosse's names were so well chosen that we can recognize the species intended even when linked to wrong scientific names. This is strikingly the case in the Graptas, for which his names were particularly appropriate and have in all but one case been adopted by Scudder.

The Violet Tip was his name for Interrogationis; the Green Comma, though doubtfully linked with the name Progne, must have been intended for Faunus, not at that time described, while the Orange Comma and the Gray Comma well indicate G. Comma and G. Progne. It is doubtless true that in English works the popular name is frequently given undue prominence, being printed in large type at the beginning of a description, while the scientific name is given in italics, or in brackets at the end of the description, and the same prominence was, I found, given to popular names in the beautiful economic exhibit from the Entomological Division of the Department of Agriculture in the U. S. Government building at the World's Fair; but it is not necessary to follow this custom, and we could very well print the scientific name first in large type and the popular name second in smaller type as is done by Mr. Scudder in his "Butterflies of New England."

But if it be agreed that the adoption of popular names is on the whole desirable, is it practicable? No doubt it is for a limited fauna like that of England or New England, but is it for the whole of North America?

Who will undertake to invent suitable popular names for the upwards of sixty species of Argynnis, the nearly forty species of Melitæa, the fifty species of Thecla, the equal number of species of Lycaena, or the upwards of ninety species now grouped under the generic name Pamphila?

I confess the idea appears to me utterly hopeless and impracticable.

THE BUTTERFLIES OF THE EASTERN PROVINCES OF CANADA.

By Rev. C. J. S. Bethune, Port Hope, Ontario.

The following list of the butterflies of the Eastern Provinces of Canada has been prepared in order to bring together in convenient form all the localities that have been published as well as those that have come under my own observation. The list is as complete as I can at present make it, but no doubt there are many collectors in different parts of the country who could add largely to the localities given, and possibly add a few more species to those here recorded. The time of flight and the food-plants are given in most instances.

The question of nomenclature and arrangement has been a difficult one to decide. It will be observed that I have followed the order of families and genera given in Dr. J. B. Smith's "List of Lepidoptera of Boreal America," (Philadelphia, 1891), and have for the most part adopted the nomenclature of Mr. W. H. Edwards's "Revised Catalogue of the Diurnal Lepidoptera of America North of Mexico," (Philadelphia, 1884). For the sake of convenience I have added in brackets Mr. Scudder's name for the species whenever it differs from that which I have employed. I have also followed Mr. Edwards in beginning the specific names with a capital letter as they are nearly all proper names and seldom adjectives.

In the preparation of this list the records of the following authors and observers have been gone over for localities in the Province of Ontario: Messrs. D. W. Beadle, St. Catharines; J. M. Denton, London; J. D. Evans, Sudbury; G. Geddes, Toronto; Rev. W. Kirby, ("Fauna Boreali-Americana: Insecta"); Theodore L. Mead, Oviedo, Florida; Prof. J. Macoun, Geological Survey of Canada, Ottawa; J. Alston Moffat, London; J. Pettit, Grimsby; E. Baynes Reed, London. For both the provinces of Ontario and Quebec: Messrs. B. Billings, Ottawa; W. H. Edwards ("Butterflies of North America, etc.); J. Fletcher, Ottawa; Prof. W. Saunders, Ottawa; S. H. Scudder ("Butterflies of the New England States and Canada"). For the Province of Quebec alone: Dr. R. Bell, Geological Survey of Canada, Ottawa; J. G. Bowles, Montreal; F. B. Caulfield, Montreal; W. Couper, Montreal; W. S M. D'Urban, Montreal; Rev. T. W. Fyles, South Quebec; P. H. Gosse, Compton, ("Canadian Naturalist"); J. G. Jack, Chateauguay Basin; H. H. Lyman, Montreal; A. F. Winn, Montreal. For Nova Scotia and New Brunswick: Mrs Heustis, St. John; J. Matthew Jones, Halifax. For Newfoundland: Capt. Brown and Mr. P. H. Gosse. For Labrador and Hudson Strait: W. Couper and Lieut. Payne. For Prince Edward Island: Prof. John Macoun,

LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ.

Sub-family *Euploeinæ*.

1. DANAIS ARCHIPPUS, *Fabr.* (*Anosia plexippus*). Abundant throughout Southern and Eastern Ontario; taken also on the shores of Georgian bay, at Sault Ste. Marie and Nepigon; rare in the Province of Quebec, taken at Montreal, Sorel, Quebec, River Rouge district, Little Metis; rare in Nova Scotia. Earliest dates, May 24, June 4, 6, 7, 12, 14; very common in July; especially abundant in August and September; latest dates, October 23, 27. Food plant, Asclepias. Fig. 1, represents the butterfly; Fig. 2, the caterpillar; Fig. 3, the successive changes to chrysalis; Fig. 4, the chrysalis.

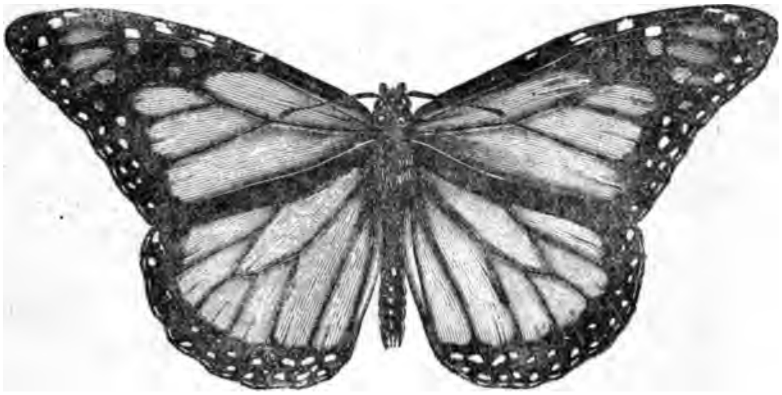


Fig. 1.

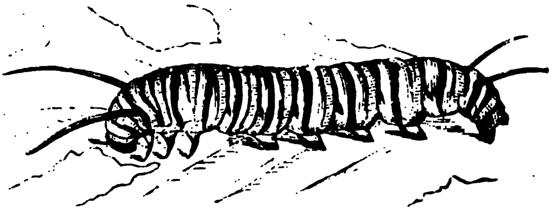


Fig. 2.

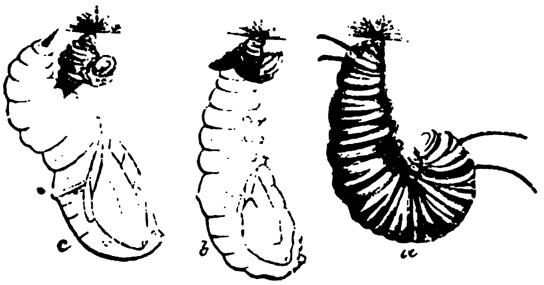


Fig. 3.

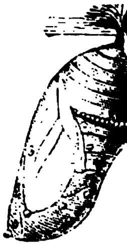


Fig. 4.

Sub-family *Nymphalinæ*.

2. EUPTOIETA CLAUDIA, *Cram.* Very rare. Has been taken at Wabigoon, Ont. (J. C. Guillim), London, St. Catharines, Chateauguay Basin, Montreal (Aug. 15, 1874); also in Manitoba and North-West Territories. Food plants—Violet, Passion Flower, Sedum, Portulaca, Desmodium, Podophyllum.

3. ARGYNNIS CYBELE, *Fabr.* Common throughout Ontario and Quebec. Taken at Nepigon, Sault Ste. Marie, Georgian bay, Cameron lake, Amherstburg, Point Pelee, London, West Flamboro', Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Eastern Townships, Quebec, Little Metis; also in Cape Breton and Prince Edward Island. Flies during July, August and September. Food plant of this and the other species of Argynnis is the various species of Violets.

4. ARGYNNIS APHRODITE, *Fabr.* Taken throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury, Cameron lake, London, Hamilton, West Flamboro', Credit, Toronto, Cobourg, Ottawa; Montreal, Sorel, Quebec, Lower St. Lawrence and Bay of Chaleur; Restigouche river, New Brunswick; Nova Scotia; Prince Edward Island; Moose Factory, James's bay. Flies during July and August.

5. ARGYNNIS ATLANTIS, *Edw.* Common throughout Northern Ontario and Eastern Quebec. Moose Factory, Nepigon, Fort William, Sault Ste. Marie, Ottawa (rare); Montreal (very rare), Co. Missisquoi, P. Q., Little Metis, Godbout river, Cacouna, Lower St. Lawrence; Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Newfoundland, Prince Edward Island. Flies during July and August.

6. ARGYNNIS ELECTA, *Edw.* Nepigon (Macoun, Fletcher, Bethune).

7. ARGYNNIS CIPRIS, *Edw.* Nepigon (Bethune and Fletcher). Sudbury (Fletcher and Evans), August.

8. ARGYNNIS MYRINA, *Cram.* (*Brenthis Myrina*). Common throughout the eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Sudbury, London, Hamilton, St. Catharines, Grimsby, Credit, Toronto, Cobourg, Rice lake, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Cacouna, Little Metis, Godbout river, Lower St. Lawrence; Metapedia river, Dalhousie, N.B., Nova Scotia, Cape Breton, Prince Edward Island. Flies during June, July and August. Taken at Montreal in May and at Ottawa in September.

9. ARGYNNIS CHARICLEA, *Ochs.* (*Brenthis Chariclea*). Port Arthur, Spanish river, Nepigon, Georgian bay (Lyman), July. Labrador, May 30 and June (Couper). Mingan, July 22. Hudson bay.

10. ARGYNNIS FREIJA, *Thunb.* (*Brenthis Freija*). Port Arthur, Fort William; Quebec, Gomin Swamp; Labrador, Hudson's straits, Cumberland House, Lat. 54° (Kirby), taken in August and September.

11. ARGYNNIS BELLONA, *Fabr.* (*Brenthis Bellona*). Common in Ontario and Quebec. Nepigon, Fort William, Sudbury, London, Credit, Hamilton, Cobourg, Ottawa Lake Temiscamingue, P. Q, Chateauguay Basin, River Rouge district, Quebec, Little Metis, Godbout river, Lower St. Lawrence, Dalhousie, N B., Moose Factory. Flies in June, July, and August.

12. ARGYNNIS TRICLARIS, *Hubn.* Ottawa, Mer Bleue (June 16, 1893); Labrador (Couper, Low).

13. MELITÆA PHAETON, *Drury.* (*Euphydryas Phaeton*). Widely distributed, but rarely seen. Flies only about swamps and the damp margins of rivers. Has been taken at Ottawa, London, Toronto, Montreal, Quebec, Nova Scotia, New Brunswick. Flies during the latter part of June and first half of July. Food plants—Chelone glabra, Lonicera and Viburnum.

14. MELITÆA HARRISII, *Scud.* (*Cinclidia Harrisii*). Very rare, though widely distributed. Sudbury, Montreal, Quebec, St. Henri, Levis, Saguenay, Gaspé; New Brunswick, Nova Scotia, Newfoundland. Taken at the end of June and up to the middle of July. Food plants—Double-bristled Aster, Diplopappus umbellatus.

15. PHYCIODES NYCTEIS, *Doubl-Hew.* (*Charidryas Nycteis*). Taken throughout Ontario and in Quebec; not common. Nepigon, Port Arthur, Sault Ste. Marie, Sudbury, London, Hamilton, Toronto Ottawa; Montreal, Quebec, Saguenay. Flies in June and July. Food plants—Helianthus (Sunflower), Actinomeris.

16. PHYCIODES CARLOTA, *Reak.* Very rare. Taken at London, (Saunders), Scarborough near Toronto, (Geddes); Nova Scotia, (Jones) "South of Lat. 40° from Atlantic to Rocky Mountains," Scudder.

17. PHYCIODES BATESII, *Reak.* Only recorded from Hamilton (Johnson) and Godbout river, P. Q. "Common in July."

18. PHYCIODES THAROS, *Drury.* (Forms MARCIA, *Edw.;* MORPHEUS, *Fabr.*) Abundant throughout Ontario, Quebec and the Maritime Provinces. Nepigon, Port Arthur, Sault Ste. Marie, Sudbury, Amherstburg, County of Essex, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Cacouna, Saguenay, Little Metis, Lower St. Lawrence, Anticosti, Labrador, New Brunswick, Nova Scotia, Cape Breton, Prince Edward Island, Newfoundland, Moose Factory. Flies during June, July and August; occasionally seen in May and September. Food plants—Chelone glabra, Aster, Actinomeris helianthoides.

19. GRAPTA INTERROGATIONIS, *Fabr.* (*Polygonia Interrogationis*). Taken throughout Ontario; rare in Quebec and Nova Scotia. Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa; Montreal, Compton, Quebec. Form UMBROSA, *Lint.* taken June 3 to 20, July 17, August 7. Form FABRICII, *Edw.* taken in August and September, occasionally in October. Food plants—Hop, Elm, Nettle, Linden, Celtis occidentalis.

20. GRAPTA COMMA, *Harr.* (Summer form DRYAS, *Edw.*; Winter form, HARRISII, *Edw. Polygonia Comma*). Common throughout Ontario; taken also in Quebec and Nova Scotia Nepigon, Cameron lake, London, Hamilton, Port Hope, Cobourg, Ottawa; Montreal, Chateauguay Basin, River Rouge district, Compton, Quebec, Anticosti; Moose Factory; Dalhousie, N.B. June, July and August. Food plant—Hop, Elm, Nettle.

21. GRAPTA SATYRUS, *Edw.* (MARSYAS, *Edw.*; *Polygonia Satyrus*). Very rare. Taken in Ontario at Cameron lake, near London, and at Ottawa. In Quebec at Chateauguay Basin and Brome. Also in Prince Edward Island. Food plant—Nettle.

22. GRAPTA FAUNUS, *Edw.* (*Polygonia Faunus*). Taken throughout the Eastern Provinces of Canada. Nepigon, North of Lake Huron, Hamilton, Cobourg, Ottawa; Montreal, Brome, Missisquoi county, Quebec, Little Metis, Gulf of St. Lawrence, Nova Scotia, Newfoundland, Moose Factory. Has been taken in each month from May to October. Food plants—Green Alder, Willow, Birch, Currant, Gooseberry.

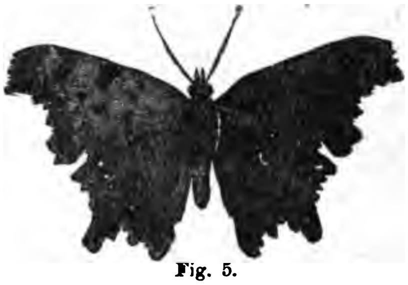


Fig. 5.

23. GRAPTA PROGNE, *Cram.* (*Polygonia Progne*). Fig 5. Common throughout the Eastern Provinces of Canada. Nepigon, Fort William, Sault Ste. Marie, Vermilion lake (Lake Huron), Sudbury, Cameron lake, Amherstburg, London, Hamilton, Credit, Port Hope, Cobourg, Peterborough, Ottawa; Montreal, River Rouge district, Eastern Townships, Quebec, Little Metis, Godbout river, Lower St. Lawrence and Bay of Chaleur, Anticosti, Restigouche river, N.B, Nova Scotia. Lat. 54° (Kirby). Flies from May to October; earliest date May 14, latest October 20. Food plants—Currant, Gooseberry, Betula papyrifera, Elm.

24. GRAPTA GRACILIS, *Grote and Rob.* (*Polygonia Gracilis*). Taken in northern Ontario and in Quebec. Nepigon, Sudbury, Quebec, Levis, Little Metis. Flies in July, August and September. Food plant—Currant.

25. GRAPTA J-ALBUM, *Boisd-Lec.* (*Eugonia J-Album*). Common throughout the Eastern Provinces of Canada. Sault Ste. Marie, Bruce Mines, north of Lake Huron, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lake Simcoe, Ottawa; Montreal, River Rouge district, County of Grenville, Eastern Townships, Sorel, Quebec, Little Metis, Godbout river, Bay of Chaleur, Labrador, Nova Scotia. Flies during August and September; hibernating specimens are often found during the winter in houses and

appear on the wing on warm days in March and April ; taken also in May and July ; autumn brood appears in September and October. Food plant—White birch.

26. VANESSA ANTIOPA, *Linn.* (*Euvanessa Antiopa*). Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, north of Lake Huron, Sudbury. Lake Simcoe, London, Credit, Toronto, Hamilton, Port Hope, Cobourg, Ottawa ; Montreal, Eastern Townships, River Rouge district, Quebec, Little Metis, Rimouski, Godbout river, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island. Hibernated specimens appear at the end of March and early in April ; common throughout the whole summer, the second brood appearing in August ; common in September, and individuals are found till the end of October. Food plants—Willow, Elm, Poplar.

27. VANESSA MILBERTI, *Godt.* (*Aglais Milberti*). As widely distributed as the preceding species. Nepigon, Sault Ste. Marie, Amherstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Eastern Townships, Quebec, Isle of Orleans, Little Metis, Godbout river, Saguenay, Labrador ; Newfoundland, Cape Breton, Nova Scotia, Moose Factory. Hibernated specimens appear in March and April ; more or less abundant throughout the summer ; individuals seen in October as late as the 18th. Food plant—Nettle.

28. PYRAMEIS ATALANTA, *Linn.* (*Vanessa Atalanta.*) Abundant throughout the Eastern Provinces of Canada. Nepigon, Sault Ste. Marie, London, Point Pelee, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Sorel, Quebec, Little Metis, Godbout River, Anticosti, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, Moose Factory. Taken from May to August ; very abundant in June when the lilacs are in blossom ; occasionally seen in October. Food plants—Nettle, Hop.

29. PYRAMEIS CARDUI, *Linn.* (*Vanessa Cardui*). Abundant everywhere. Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Grand Metis, Godbout river, Anticosti ; Dalhousie and St. John, N.B , Nova Scotia, Newfoundland, Prince Edward Island. Flies at the end of May and throughout the summer months till September ; occasionally seen in October. Food plants—Thistle, Mallow, Hollyhock, Burdock, Wild Sunflower.

30. PYRAMEIS HUNTERA, *Fabr.* (*Vanessa Huntera*). Widely distributed, but not so abundant as the preceding species. Nepigon, Sault Ste. Marie, Point Pelee, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa ; Montreal, Quebec, Isle of Orleans, Little Metis, Godbout river, St. John, N.B., Nova Scotia. Flies in July, August and September. Food plants—Gnaphalium, Thistle, Myosotis.

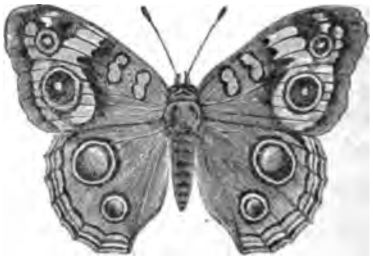


Fig. 6.

31. JUNONIA CŒNIA, *Hubn.* Fig. 6. Very rare in Canada. Has been taken at Chatham, Port Stanley, London, Stratford and Ridgeway in Ontario. Food plants—Gerardia, Antirrhinum, Plantago, Linaria Canadensis.

32. LIMENITIS ARTHEMIS, *Drury.* (*Basilarchia Arthemis*). Abundant throughout the Eastern Provinces of Canada. Lake of the Woods, Nepigon, Sault Ste. Marie, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Lakefield, Belleville, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Sherbrooke, Little Metis, Godbout river, Lower St. Lawrence, Tobique river, N.B., Nova Scotia, Cape Breton, Newfoundland, Moose Factory. Flies in June, July and August, often seen in immense numbers. Food plants—Willow, Black and Yellow Birch, Poplar, Thorn, Plum, Cherry, Amelanchier.

33. LIMENITIS PROSERPINA, *Edw.* (*Basilarchia Proserpina*). Excessively rare. Specimens have been taken at Hamilton, Roachs' Point, Lake Simcoe (August 22, 1894), Rideau Hall, Ottawa, and Halifax, N.S.

34. Limenitis Ursula, *Fabr.* (*Basilarchia Ursula.*) Very rare in Canada. Has been taken at Port Stanley, London, and in Essex county, Ontario. Plentiful at London 1893 (Moffat). Food plants—Cherry, Currant, Oak, Willow, Vaccinium, Apple, Quince, Hawthorn, Plum.

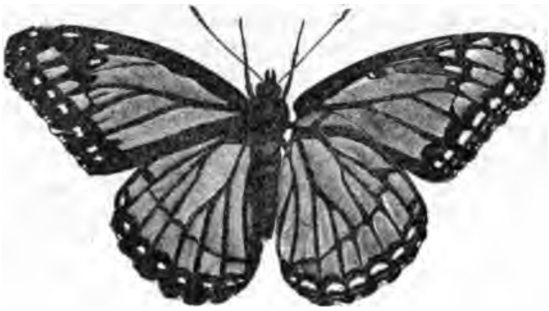


Fig. 7.

35. Limenitis Disippus, *Godt.* (*Basilarchia Archippus.*) Widely distributed, but not very abundant. Amherstburg, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Rice lake, Ottawa, Montreal, L'Orignal, Little Metis, St. John, N.B., Nova Scotia. Flies in June, July and August; occasionally seen in September and October.

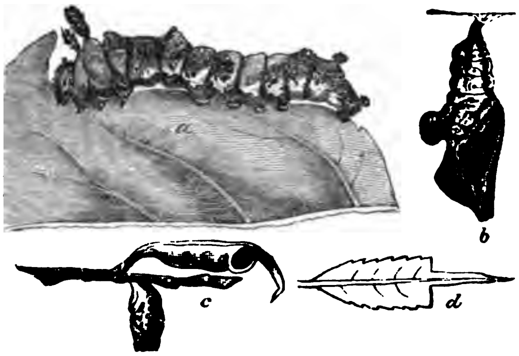


Fig. 8.

Food plants—Willow, Poplar, Plum, Apple, Oak. Fig. 7 the butterfly; fig. 8, *a*, the larva, *b*, the chrysalis, *c* and *d*, the larva case.

Sub-family *Satyrinæ*.

36. Debis Portlandia, *Fabr.* (*Enodia Portlandia.*) Very rare. In Ontario it has only been taken at Ottawa. In Quebec at Hull and Kirk's Ferry, Montreal, Chateauguay Basin, River Rouge district, Eastern Townships, Compton, Quebec; Nova Scotia. Flies in July and August. Food plants—Grasses.

37. Neonympha Canthus, *Boisd-Lec.* (*Satyrodes Eurydice*, Linn; *Neonympha Boisduvallii*, Harris.) Not very abundant. Has been taken at Sault Ste. Marie, Essex county, London, Hamilton, Toronto, Grafton and Ottawa (common) in Ontario; at Montreal, Compton and Quebec; Mingan Islands, Nova Scotia. Flies in June, July and August. Fig. 9. Food plants—Grasses and Sedges.

38. Neonympha Eurytris, *Fabr.* (*Cissia Eurytris.*) Widely distributed, and not uncommon. Sudbury, Essex county, London, Hamilton, Credit, Toronto, Port

Hope, Cobourg, Rice lake, Ottawa, Montreal, Eastern Townships, Quebec. Flies in June and July. Fig. 10. Food plant—Grasses.

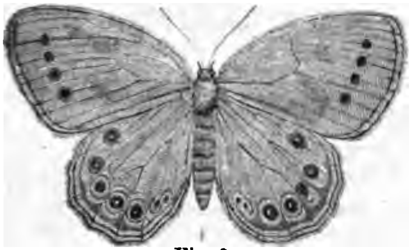


Fig. 9.

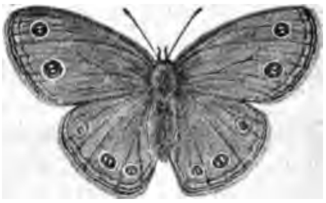


Fig. 10.

39. **Cœnonympha inornata**, *Edw.* A very rare butterfly. Taken at Massasauga Point (Macoun), Lake Winnipeg, Sault Ste. Marie, and in Newfoundland and Labrador.

40. **Erebia Discoidalis**, *Kirby.* The only Eastern Canadian record is its capture at Sudbury by Mr. J. D. Evans, May 12, 1889.

41. **Satyrus Nephele**, *Kirby.* (*Cercyonis Nephele.*) Abundant throughout the Eastern Provinces of Canada, County of Essex, London, St. Catharines, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Quebec, Little Metis, New Brunswick, Nova Scotia, Prince Edward Island. Flies throughout July and August; taken from June 10 to 20, in Essex county, Ontario. Food plant—Grasses.

42. **Satyrus Alope**, *Fabr.* (*Cercyonis Alope.*) This more southern form has been taken at St. John, N.B., and in Nova Scotia and Prince Edward Island.

43. **Chionobas Macounii**, *Edw.* (*Oeneis Macounii.*) This rare butterfly has only been taken at Nepigon, from June 28 to July 13. Food plant—Sedges.

44. **Chionobas Jutta**, *Hubn.* (*Oeneis Jutta.*) A very rare and local sub-arctic species. Has been taken at Nepigon, Ottawa, the Gomin Swamp, Quebec, Bergerville, P.Q., and in Labrador. Food plant—Carices.

Sub-family *Libytheinæ.*

45. **Libythea Bachmani**, *Kirtl.* (*Hypatus Bachmanii.*) Fig 11. Very rare in Canada. Has been taken at Port Stanley, London and Hamilton in August. Food plant—Celtis.

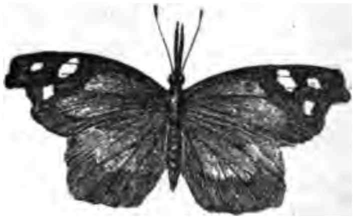


Fig. 11.

Family LYCÆNIDÆ.

Sub-family *Lycæninæ.*

46. **Thecla Acadica**, *Edw.* Rare. Has been taken at London, Hamilton, Ottawa, Montreal and St. Rose, P.Q. Flies in July. Food plant—Willow.

47. **Thecla Melinus**, *Hubn.* (*Uranotes Melinus.*) Very rare in Canada. Has been taken at London, Hamilton, Montreal. Flies in July. Food plants—Hops, Beans, Cynoglossum, Cratægus.

48. **Thecla Edwardsii**, *Saund.* (*Falacer*, Harris.) Very rare. Has been taken at London, Hamilton, Credit and Ottawa (rare), in July. Food plant—Oak.

49. **Thecla Calanus**, *Hubn.* (*Inorata*, Grote-Rob; *Falacer*, Godt.) Usually rare, but sometimes abundant. Has been taken at London, Hamilton, Ottawa and Montreal, in July and August. Food plants—Oak, Butternut, Hickory.

50. **Thecla Ontario**, *Edw.* Taken only at Port Stanley, Ont., by Mr. E. B. Reed, in July, 1868.

51. Thecla Strigosa, *Harr.* (*Liparops*, Scud.) Rare. Taken at Cameron Lake, London, Ottawa and Montreal, July. Food plants—Thorn, Shadbush (*Amelanchier*), Blueberry (*Vaccinium*), Plum.

52. Thecla Smilacis, *Boisd-Lec.* (*Mitura Damon*, Cram.) Has been taken only at Point Pelee, Ont., by Mr. Saunders. Food plant—Red Cedar.

53. Thecla Augustus, *Kirby.* (*Incisalia Augustus.*) Has been taken at London and Ottawa, Montreal, Bergerville and Quebec, and at Halifax, N.S.

54. Thecla Irus, *Godt.* (*Incisalia Irus*) This very rare butterfly has been taken at Nepigon by Mr. Macoun, and at Montreal by Mr. Bowles. Food plant—Wild Plum.

55. Thecla Niphon, *Hubn.* (*Incisalia Niphon.*) Rare. Has been taken at London and Ottawa, Montreal, Chelsea, Sorel, P.Q., Halifax, N.S. Flies in May. Food plant—Pine.

56. Thecla Læta, *Edw.* (*Erora Læta.*) Very rare. Taken at London and York Mills, Ont., Beloeil Mountain, St. Joachim, St. Hilaire and Quebec. Flies during the latter part of May.

57. Thecla Titus, *Fabr.* (*Mopsus*, Hubn.; *Strymon Titus.*) Widely distributed, but rather rare in Canada. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Ottawa, Montreal, Oka, Eastern Townships, Quebec. Flies in July and August. Food plants—Wild Cherry, Oak.

58. Feniseca Tarquinius, *Fabr.* Widely distributed, but not common. Sudbury, London, Hamilton, Credit, Toronto, Stony Lake, Ottawa, Montreal, Cowansville, Township of Stanbridge, Island of Orleans, P.Q.; Halifax, N.S. Has been taken from May 24th, through the summer to September. Larva feeds upon plant lice (Aphides).

59. Chrysophanus Thoe, *Boisd.-Lec.* Taken in Ontario and Quebec, but very locally on the margin of rivers or lakes. Nepigon, London, Hamilton, Port Hope, Cobourg, Ottawa, Montreal, Lachine, Quebec, Eastern Townships. Flies in August and earlier part of September. Figs. 12 and 13. Food plants—Rumex and Polygonum.

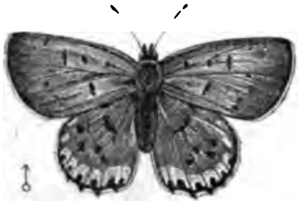


Fig. 12.

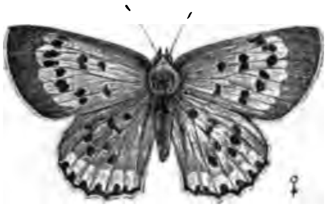


Fig. 13.

60. Chrysophanus Florus, *Edw.* Five specimens of this rare butterfly were taken at Nepigon by Prof. Macoun. It has also been taken by Capt. Brown in Newfoundland.

61. Chrysophanus Dorcas, *Kirby.* Kirby's record is lat. 54°. It is reported from Labrador in July.

62. Chrysophanus Epixanthe, *Boisd.-Lec.* (*Epidemia Epixanthe*). Rarely seen, but very widely distributed; frequents the borders of swamps and peaty meadows. Has been taken at London, Toronto, Ottawa, Montreal, the Gomin Swamp, Quebec, Cape Breton, Newfoundland. Flies in July. Food plant unknown.

63. Chrysophanus Hypophlæas, *Boisd.* [*C. Americana D'Urban*] (*Heodes Hypophlæas*). Very common throughout Ontario and Quebec. Nepigon, Sault Ste. Marie, Sudbury, county of Essex, London, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, River Rouge district, Eastern Townships, Sorel, Quebec, Cacouna, Little Metis, Prince Edward Island, Moose Factory. Flies from the end of May to September. Food plant—Sheep's Sorrel (*Rumex acetosella*).

64. Lycæna Pembina, *Edw.* Has been taken at Cacouna, P.Q., by Mr. Saunders in July, 1866 (*Can. Ent.*, Vol. I., p. 12).

65. Lycæna Couperii, *Grote*. Rare. Has been taken at Nepigon and Brantford, Ont.; Heights of Levis, Cacouna, Little Metis and Godbout river, P. Q., Anticosti, Labrador, Newfoundland.

66. Lycæna Scudderii, *Edw*. (*Rusticus Scudderii*). Locally abundant. Has been taken at Nepigon, London, Toronto, Cobourg, north shore of the St. Lawrence, Anticosti, Labrador, Hudson bay. Cape Breton. Flies at the end of May, in June and August. Food plant—Lupin.

67. Lycæna Pseudargiolus, *Boisd-Lec*. (Winter forms Lucia, *Kirby*; Violacea, *Edw*.; summer form Neglecta, *Edw* —*Cyaniris Pseudargiolus*). Very widely distributed. Nepigon, Sudbury, London, Hamilton, St. Catharines, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Eastern Townships, River Rouge district, Quebec, Riviere du Loup, Godbout river, Anticosti, lower St. Lawrence, Labrador, Prince Edward Island. Lat. 54° (Kirby). Appears very early in the spring, and may be found in April and May (forms *Lucia* and *Violacea*); in June and July in the more northern localities; the form *Neglecta* is found during June, July and August, and into September. Food plants—Cornus, Actinomeris, Viburnum, Acer spicatum, Willow, and a great variety of other plants (vide Scudder's Butterflies of the Eastern United States and Canada, p. 938).

68. Lycæna Comyntas, *Godt*. (*Everes Comyntas*). Not uncommon. Has been taken at Nepigon, Sudbury, London, Hamilton and Ottawa; Montreal, Lachine, Chateauguay Basin. Flies in May, June, July and August. Food plants—Leguminous plants, Lespedeza, Desmodium, Clover, Lathyrus.

Family Papilionidæ.

Sub-family *Pierinæ*.

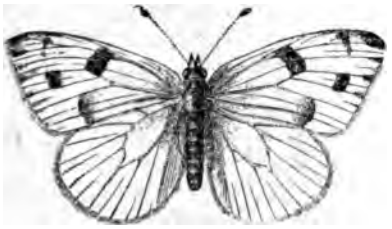


Fig. 14.

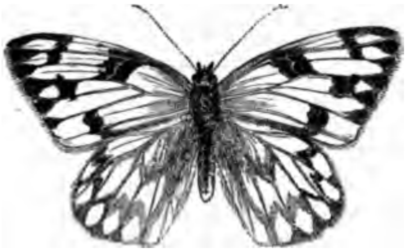


Fig. 15.

69. Pieris Protodice, *Boisd.-Lec*. (*Pontia Protodice*). Formerly common, but now rarely seen. Sault Ste. Marie, Amherstburg, Port Stanley, London, Hamilton, Toronto, Cobourg, Lachine, P.Q. Has been taken from May to October. Food plants—Cabbage and other cruciferous plants. Fig. 14, male; fig. 15, female; fig. 16—*a* larva, *b* chrysalis.

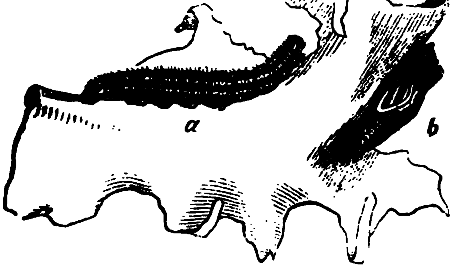


Fig. 16.

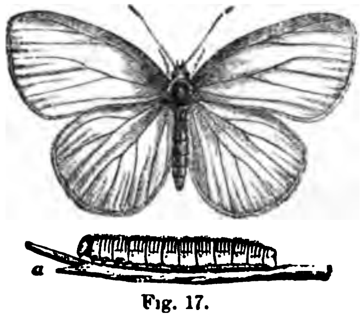


Fig. 17.

Fig. 18.

70. Pieris Napi, *Esper*. (Forms Oleracea-hiemalis, *Harr.;* Borealis, *Grote;* Frigida, *Scud.;* Virginiensis, *Edw.;* Oleracea-æstiva, *Harris*). Taken throughout the Eastern Provinces of Canada. Formerly very abundant, but since the wide-spread introduction of *P. rapæ*, this and the preceding species have become quite rare. Recorded from Nepigon, Sault Ste. Marie, Bruce Mines, north of Lake Huron, Sudbury, Collingwood, Amherstburg, London, Hamilton, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Cowansville, River Rouge district, Quebec, Little Metis, Lower St. Lawrence, Anticosti, Labrador, Newfoundland, Cape Breton. Lat. 65° (Kirby). Hudson Bay. The form *Borealis* has been taken at Godbout river, P.Q.; *Frigida* at Mingan, Anticosti and the south and east coasts of Labrador; the aberrant form *Virginiensis* at Hamilton and Fort William. Food plants—Turnips and other cruciferous plants. Fig. 17 butterfly, and *a* the larva; fig. 18 chrysalis.

71. Pieris Rapæ, *Linn*, and aberrant form *var* Novæ Angliæ, *Scud.* Since its introduction to this country at Quebec, in 1858, it has spread over a large portion of the continent, and is everywhere one of the commonest butterflies. Flies from April to October. Food plants—Cabbage and other cruciferous plants, mignonette, stocks. Fig. 19, male butterfly; fig. 20, female; fig. 21—*a* larva, *b* chrysalis.

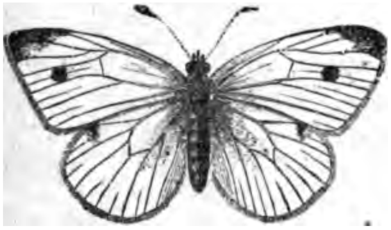


Fig. 19.

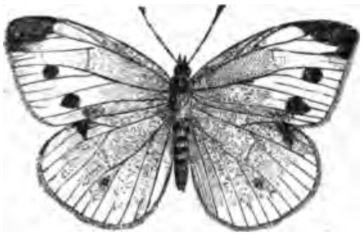


Fig. 20.

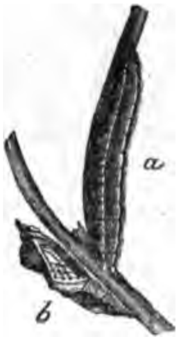


Fig. 21.

72. Colias Cæsonia, *Stoll.* (*Zerene Cæsonia*). Mr. Scudder gives "Southern Ontario" as one of its localities, but I can find no recorded place of capture. Mr. Moffat tells me that it was taken at Long Point, Lake Erie. Food plants—Clover, Amorpha.

73. Colias Eurytheme, *Boisd.* [Forms Keewaydin, *Edw.*; Eriphyle, *Edw.*] (*Eurymus Eurytheme*). Abundant north of Lakes Superior and Huron; occasionally taken in more southern localities. Nepigon, Fort William, Port Arthur, Bruce Mines, Sault Ste. Marie, London, St. Catharines, Port Hope (Oct. 15), Ottawa, Hull, Montreal, Missisquoi county, Quebec. Food plant—White Clover.

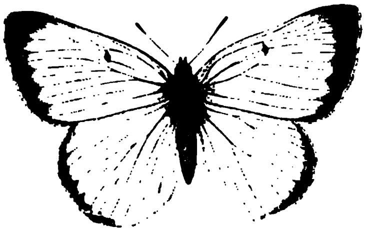


Fig. 22.

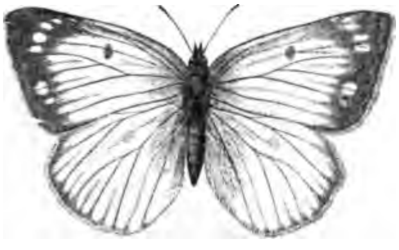


Fig. 23.

74. Colias Philodice, *Godt.* (*Eurymus Philodice*). One of the commonest butterflies throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. Abundant from the middle of May to September; occasionally taken as early as April 9th, and as late as October 19th. Food plants—Clover, Pea, Lupin. Fig. 22, male; fig. 23, female.

75. Colias Interior, *Scud.* (*Eurymus Interior*). Abundant north of Lakes Superior and Huron; occasionally taken further east. Nepigon, Port Arthur, Fort William, Spanish river, Georgian bay, Sudbury, Ottawa, Montreal, Owl's Head Mountain, Quebec, Heights of Levis, Moose Factory. Flies in July and August. Food plant—Willow.

76. Colias Interior, *var* Laurentina *Scud.* Is recorded from Montreal (Caulfield, July, 1874); Quebec (Fyles); Godbout river, Anticosti, Mingan, Labrador, Newfoundland, Prince Edward Island, Cape Breton.

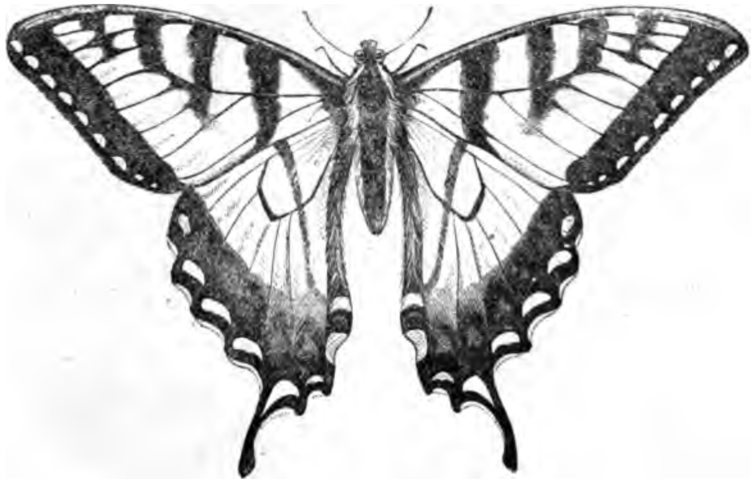
77. Terias Nicippe, *Cram.* (*Xanthidia Nicippe.*) This southern butterfly has been once taken at Point Pelee, Ont. Food plant—Cassia.

Terias Mexicana, *Boisd.* has also been taken at Point Pelee, by Mr. Saunders, June 29, 1882.

78. Terias Lisa, *Boisd-Lec.* (*Eurema Lisa*) Has been taken at Point Pelee (June 29, 1882, Saunders); Port Stanley (August, 1861); London, Hamilton (Moffat, June 23, 1882,) Food plants—Clover, Cassia.

Sub-Family, *Papilioninæ.*

79. Papilio Ajax, *Linn.* [Form Marcellus, *Boisd.*] (*Iphiclides Ajax.*) Occasionally taken in June in the extreme southern parts of Ontario, North Ridge, county of Essex, Point Pelee, Long Point, Ridgeway, Komoka, near London. Food plant—Pawpaw.



. Fig. 24.

80. Papilio Turnus, *Linn.* (*Jasoniades Glaucus.*) Abundant throughout the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island; also in Newfoundland. Flies during the latter part of May, throughout June and part of July, sometimes in enormous numbers. Food plants — Apple, Thorn, Aspen, Poplar, Willow, Cherry, Alder, Basswood, Oak, Black and White Ash, Birch, Aspen, Tulip wood, Amelanchier Canadensis. Fig. 24, butterfly; Fig. 25, caterpillar.

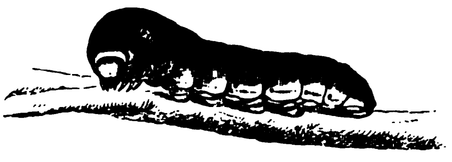


Fig. 25.

81. Papilio Oresphontes, *Cram.* (*Papilio* [illegible] Fig. 26. Spreading gradually through southwestern Ontario. Has been taken in the

county of Essex, at Amherstburg, Sandwich, Windsor, Belle Isle, Chatham, Point Pelee, St. Thomas, Long Point, Thedford, Dunnville, London, Dundas, Hamilton, Ridgeway,

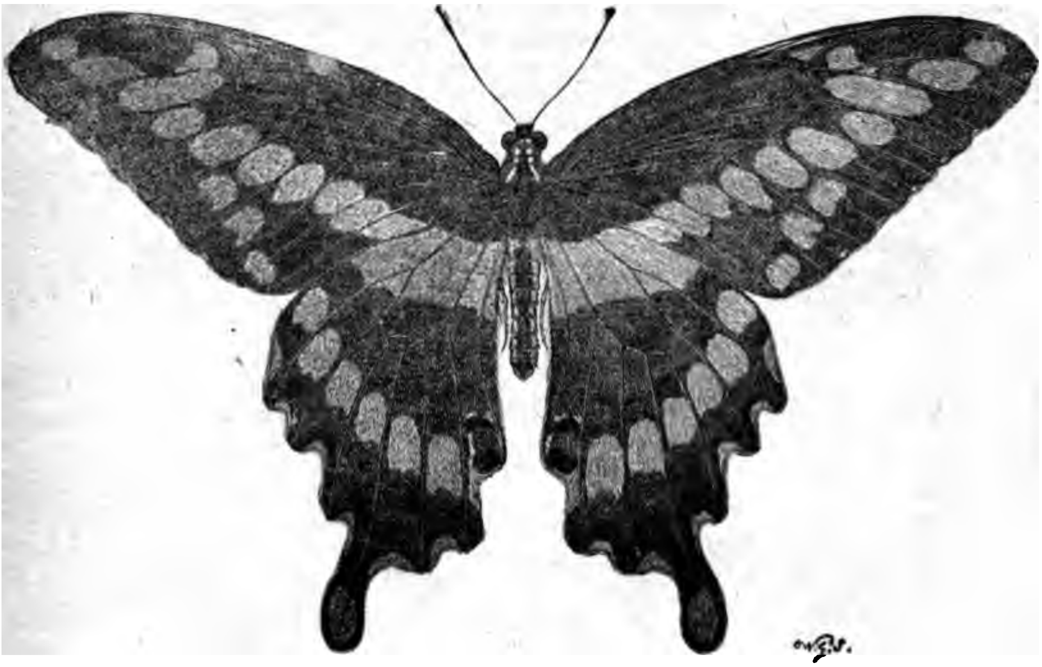


Fig. 26.

Toronto, Roach's Point, Lake Simcoe, Sparrow lake. In Quebec at Chateauguay Basin and at St. John, N. B. Flies in June, July and August. Food plants—The Citrus family, Rutaceæ, Prickly Ash, Hop-tree (*Ptelea trifoliata*) Dictamnus fraxinella, Ruta graveolens.

82. Papilio Brevicauda, *Saunders*. Taken only in the extreme east; Godbout River, Anticosti, Labrador, Newfoundland, Gaspè and Dalhousie, N. B. Food plants—Ligusticum, Pastinaea.

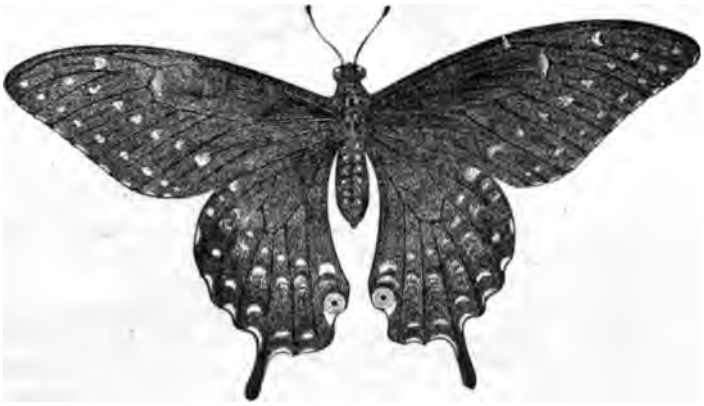


Fig. 27.

83. Papilio Asterias, *Fabr. Papilio, Polyxenes.*) Fig. 27. Abundant throughout the western peninsula and eastern parts of Ontario; not common in the Province of

Quebec. County of Essex, Amherstburg, London, West Flamboro, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, "150 miles east and west of Quebec" (Bowles), Lorette, Cacouna, Little Metis, Labrador, New Brunswick, Newfoundland. Flies at the end of May and through June, July and August; most abundant during the last-named month. Food plants—Celery, Carrot, Parsley and other umbelliferous plants.

84. **Papilio Troilus**, *Linn.* (*Euphœades Troilus.*) Confined to the western peninsula of Ontario, where it is common. County of Essex, Point Pelee, Dunnville, London, West Flamboro, Hamilton, St. Catharines, Credit. Flies during June, July and August. Food plants—Spice bush, Sassafrass.

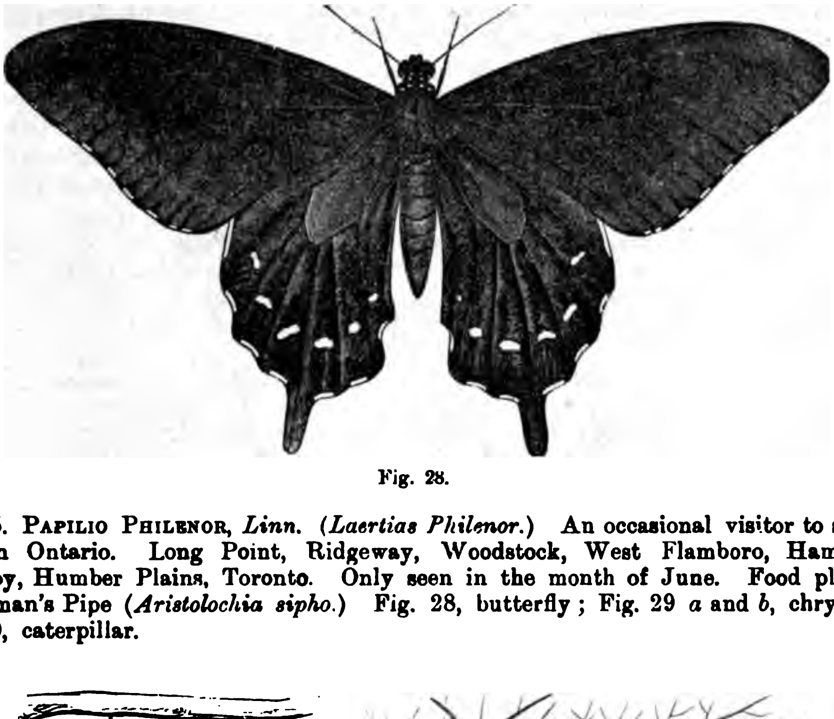


Fig. 28.

85. **Papilio Philenor**, *Linn.* (*Laertias Philenor.*) An occasional visitor to south-western Ontario. Long Point, Ridgeway, Woodstock, West Flamboro, Hamilton, Grimsby, Humber Plains, Toronto. Only seen in the month of June. Food plant—Dutchman's Pipe (*Aristolochia sipho.*) Fig. 28, butterfly; Fig. 29 *a* and *b*, chrysalis; Fig. 30, caterpillar.

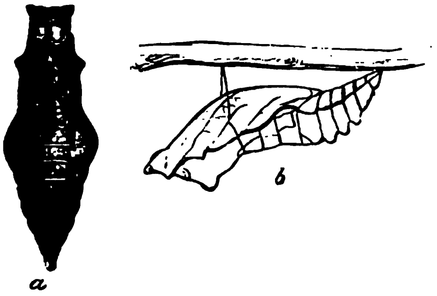


Fig. 29.

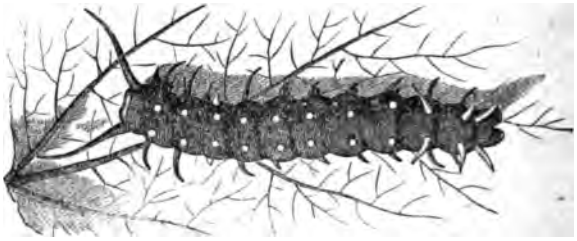


Fig. 30.

Family *Hesperidæ*.

86. **Carterocephalus Mandan**, *Edw.* Taken in the northern parts of Ontario and in Quebec. Nepigon, Sault Ste. Marie, St. Joseph's Island, Lake Huron, Sudbury, Bobcaygeon, Ottawa, Lake Mistassini, Lachine, Compton, Bergerville, Levis, Quebec, Godbout river, Anticosti, Labrador. Flies in June and July. Food plant—Grass.

87. **Ancyloxypha Numitor**, *Fabr.* (*Heteropterus Marginatus*, *Harris.*) Widely distributed but extremely local. Point Pelee, London, Hamilton, Grimsby, St. Cathar-

ines, Township of Shefford, River Yamaska, P. Q. Has been taken in June, August and September. Frequents low marshy places. Food plant—Grass.

88. Pamphila Massasoit, *Scud*, (*Poanes Massasoit.*) Only recorded by Mr. Scudder as from " Ontario (Saunders)."

89. Pamphila Zabulon, *Boisd.-Lec.* [Forms Hobomok, *Harris*; Pocohontas, *Scud.*] (*Atrytone Zabulon*). Not uncommon in one or other of its forms throughout Ontario and Quebec. Taken at Nepigon, Sudbury, county of Essex, London, Hamilton, Credit, Toronto, Ottawa. Montreal, Chateauguay Basin, Compton, Quebec, Dalhousie, N. B., Nova Scotia. Flies in June and July. Food plant—Grass.

90. Pamphila Manitoba, *Scud.* (*Erynnis Manitoba.*) Inhabits northern Ontario and Quebec. Nepigon, Sudbury, Kirk's Ferry, Quebec, Levis, Cacouna, Riviere du Loup, Little Metis, Gaspe. Taken in July, August and September.

91. Pamphila Leonardus, *Harris.* (*Anthomaster Leonardus.*) Taken sparingly in Ontario and Quebec. London, Hamilton, Credit, Toronto, Port Hope, Chelsea, Hull, Montreal, Chateauguay Basin. Flies in July and September. Food plant—Grass.

92. Pamphila Otho, *Sm.-Abb.* [Variety Egeremet, *Scud.*], (*Ætna, Scud*). Very rare. Has been taken at Hamilton, London, Prescott, and in the Eastern Townships, P. Q. (Fyles).

93. Pamphila Peckius, *Kirby.* [Wamsutta, *Harris*] (*Polites Peckius.*) Common and very widely distributed. Nepigon, Sudbury, London, Hamilton, Credit, Toronto, Port Hope, Cobourg, Ottawa, Montreal, Quebec, Little Metis, New Brunswick, Nova Scotia, Cape Breton, Moose Factory, Prince Edward Island. Flies in June, July, and occasionally in August. Food plant—Grass.

94. Pamphila Mystic, *Scud.* (*Thymelicus Mystic.*) Frequents the same localities as the preceding. Nepigon, Sudbury, London, Hamilton, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec, Cacouna, Ha ! Ha ! bay ; Nova Scotia, New Brunswick and Prince Edward Island. Flies in June, July and August. Food plant—Carex.

95. Pamphila Cernes, *Boisd.-Lec.* [Ahaton, *Harris.*] (*Limochores Taumas, Fabr.*) Very abundant throughout eastern Canada. Nepigon, London, Hamilton, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Eastern Townships, Quebec, Nova Scotia, Cape Breton, Prince Edward Island. Flies in June and July. Food plant—Grass.

96. Pamphila Manataaqua, *Scud.* (*Limochores Manataaqua.*) The only Canadian localities I have found are " Canada West" (British Museum Catalogue) ; Prince Edward Island (Macoun.)

97 Pamphila Metacomet, *Harris.* (*Euphyes Metacomet.*) Not common. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Heights of Levis. In July. Food plant—Carex.

98. Pamphila Pontiac, *Edwards.* (*Limochores Pontiac.*) The only Canadian locality is Montreal (Caulfield, teste Strecker.)

99. Pamphila Dion, *Edw.* (*Limochores Palatka, Edw.*) Taken only at Hamilton by Mr. Moffat.

100. Pamphila Viator, *Edw.* (*Phycanassa Viator.*) This southern butterfly has been taken at Hamilton by Mr. Moffat, and on the Humber Plains near Toronto by Mr. Geddes.

101. Pamphila Vitellius, *Sm.-Abb.* [*Delaware, Edw.; Logan, Edw.*] Taken only at London by Mr. Saunders.

102. Amblyscirtes Vialis, *Edw.* Rare. Has been taken at Nepigon, Sudbury, London, Ottawa, Chelsea, Montreal and Eastern Townships. In June and July. Food plant—Grass.

103. Amblyscirtes Samoset, *Scud.* Occurs even more rarely than the preceding. Has been taken at Ottawa, May 27, 29 ; Eastern Townships and Levis, P.Q., Nova Scotia. Flies in the end of May and in June.

104. PYRGUS TESSELLATA, *Scud.* (*Hesperia Montivaga, Reak*). A southern and western species which has only been reported from Essex county, Ontario. (Lowe, Can. Ent., vii., p. 140.)

105. PYRGUS CENTAUREÆ, *Ramb.* (*Hesperia Centaureæ*). A northern circumpolar species. It has been taken at Wabigoon, on the C. P. R. (about 200 miles west of Fort William), and in Labrador (Low).

106. NISONIADES BRIZO, *Boisd.-Lec.* (*Thanaos Brizo*). Widely distributed, but not very common. Sudbury, London, Hamilton, Toronto, Ottawa, Montreal, Quebec, Nova Scotia, Prince Edward Island. Flies in June. Food plant—Scrub Oak.

107. NISONIADES ICELUS, *Lint.* (*Thanaos Icelus*). Abundant locally, but not common. Nepigon, Sudbury, Hamilton, Ottawa, Montreal, Quebec, Nova Scotia. Flies in June and July. Food plants—Aspen, Willow, Witch-hazel.

108. NISONIADES LUCILIUS, *Lint.* (*Thanaos Lucilius*). Only recorded in Ontario from London and Ottawa. Flies in May, July and August. "In 1893 so abundant at Ottawa as to be noticeably injurious to garden Columbines" (Fletcher). Food plant—Wild Columbine (Aquilegia Canadensis).

109. NISONIADES PERSIUS, *Scud.* (*Thanaos Persius*). Has been sparingly taken in the county of Essex, London, Hamilton, Toronto, Ottawa and at Saguenay, P. Q. Flies in May and June. Food plants—Willow, Poplar.

110. NISONIADES MARTIALIS, *Scud.* (*Thanaos Martialis*). A southern species, which has been taken at London, Hamilton and Toronto.

111. NISONIADES JUVENALIS, *Fabr.* (*Thanaos Juvenalis*). Not common. Has been taken at London, Hamilton, Toronto, Cobourg, Ottawa (rare). Flies in May and early June. Food plants—Oak and various leguminous plants.

112. PHOLISORA CATULLUS, *Fabr.* Not common. Has been taken in the county of Essex, Point Pelee, London, Hamilton, Toronto, Eastern Townships and Quebec. Flies in June Food plants—Chenopodium, Aramantus.

113. EUDAMUS ELECTRA, *Lint.* (*Thorybes Electra*). This butterfly has only been taken by Mr. Moffat at Hamilton. The only specimen, a female, is in the possession of Dr. Holland, of Pittsburg, Penn.

114. EUDAMUS PYLADES, *Scud.* (*Thorybes Pylades*) Common in certain localities. Has been taken at Nepigon, Sudbury, London, Hamilton, Ottawa, Montreal, Chateauguay Basin. Flies in May, June and July. Food plants—Clover, Lespedeza and other leguminous plants.

115. EUDAMUS BATHYLLUS, *Sm.-Abb.* (*Thorybes Bathyllus*). This southern species has been taken in the county of Essex, at London, Hamilton, Toronto, Rice lake, Ottawa. Flies in June and July.

116. EUDAMUS TITYRUS, *Fab.* (*Epargyreus Tityrus.* Very widely distributed throughout Ontario and Quebec; common, but not numerous. County of Essex, Point Pelee, London, Hamilton, St. Catharines, Credit, Toronto, Port Hope, Ottawa, Montreal, Chateauguay Basin, Quebec. Flies in May, June and July. Food plant—Locust, Acacia, Lathyrus palustris, Apios tuberosa.

POSTSCRIPT.—Since this list was prepared I have learnt that the following species has been taken within our limits:

117. LYCÆNA AQUILO, *Boisd.* [*Franklinii, Curtis*]. This northern species was taken at Nepigon by Mr. Fletcher, July 7, 1894. It is also reported from Labrador, Hudson straits, Newfoundland (Gosse).

The following species do not come strictly within the limits that we have adopted, but may be mentioned as possible additions to our fauna:

ARGYNNIS POLARIS, *Boisd.* Hudson straits (Payne and Bell).

CHIONOBAS CALAIS, *Scud.* Rupert House, Hudson bay; Newfoundland.

CHIONOBAS TAYGETE, *Hubner*. Hudson straits (Payne).

CHIONOBAS SEMIDEA, *Say*. Labrador, Hudson straits, Newfoundland.

CHIONOBAS CRAMBIS, *Frey*. Hudson straits (Payne).

CHIONOBAS ŒNO, *Boisd.* Labrador (Couper).

CHIONOBAS BORE, *Esp.* Labrador (Couper).

LYCÆNA ASTER, *Edw.* Newfoundland (Gosse, Mead).

LYCÆNA LYGDAMUS, *Doubl.* Labrador (Couper).

PAPILIO MACHAON, *Linn.* Rupert House, Hudson bay (Payne).

COLIAS BOOTHII, *Curt.*, *var.* CHIONE, *Curt.* Hudson straits (Payne, Geddes, Can. Ent., xxi., 59).

COLIAS HECLA, *Lef.* Hudson Straits (Payne).

COLIAS EDWARDSII, *Behr.* Fort William (Geddes).

COLIAS NASTES, *Boisd.* Labrador; Hudson straits (Payne).

COLIAS LABRADORENSIS, *Scud.* Labrador.

COLIAS SCUDDERII, *Reak.* Labrador, Hudson bay.

THE PITCHER-PLANT MOTH.

(*Exyra Rolandiana*, Grt.)

BY JAMES FLETCHER, OTTAWA.

There are few of our native plants of so much interest as our native pitcher-plant, *Sarracenia purpurea*, from its peculiar beauty and the curious shape of its leaves and flowers, and there are few insects more interesting than the pretty little moth *Exyra Rolandiana*, of which the caterpillars or cocoons may generally be found by making a close search inside the leaves of the pitcher-plant during the month of June or early in July.

This moth was first described by Mr. A. R. Grote in *Psyche*, vol. ii., 1877, page 38, from specimens reared by Mr. Roland Thaxter, at Newton, Mass. It is a small, thick-set insect, about three-eighths of an inch in length, of a dark, metallic, purplish hue which on the forewings is relieved by a yellowish discal patch. The base of the wings is deep red. The dark color on the wings of the females is much blacker than in the other sex. The hind wings in both sexes are black. When at rest the wings are sloped like those of a *Plusia*.

In the *Canadian Entomologist* for 1874, vol. vi, page 207, Prof. Riley contributed an article "On the Insects More Particularly Associated with *Sarracenia variolaris*," and in this article he treats of the closely allied moth, *Xanthoptera semicrocea*, in a most entertaining manner, giving figures of all its stages. The insect-catching power of the pitcher-plants is well known and has been frequently referred to. By an examination of the decaying remains, which may be at any time found in the leaves, it will be seen that insects of almost all orders fall a prey to these treacherous death traps. Ants, however, seem to far outnumber all other kinds of insects, and Prof. Riley suggests that the acidulous properties which their decomposing bodies give to the liquid, with which the lower portion of the pitcher is always filled, render it all the more potent as a solvent of the bodies of the entrapped insects, from which doubtless the plants derive benefit, if indeed they be not, as some believe, truly insectivorous. The leaf of the pitcher plant, from its shape, namely that of a hollow tube tapering to a point at the base, swollen a little above the middle and contracted at the mouth, forms a trap from which it is very difficult for any insects to escape when they have once entered. In addition to the shape of the leaf there are other characters which add to the difficulty of egress. Above the mouth of the pitcher is a wide expanded hood with stiff bristles pointing down towards the opening, and any insect settling upon this expansion is unconsciously directed toward the danger lying beneath, by finding it, when attempting to walk, much easier to go in the direction of the bristles. The orifice of the pitcher is highly polished and difficult for most insects to find a footing upon; experience shows that a great many fall into the trap. Once inside, they are met with new dangers; the lower third of the pitcher is filled with water, and should they succeed in crawling out of this, the upper portion of the tubes down to the swollen part is thickly beset with fine bristles pointing downward, so that it is almost impossible for luckless captives to regain their liberty. There are, however, a few kinds of insects which are able to brave these dangers with impunity. One of these is a large flesh fly, of which the white maggots may generally be found during the summer revelling in the decomposing remains of other insects at the bottom of the pitcher. When full-grown, they bore their way out through the walls of the leaf and pupate in the surrounding moss. Another species is the pretty little moth referred to above, of which I have studied a few specimens every summer for the last three years.

My first acquaintance with this insect was upon finding the moth inside a pitcher in June, 1890. Since that time I have collected similarly located larvæ of various sizes and the cocoons. I have also bred the larvæ from atter the third moult in confinement.

Mr. Roland Thaxter says: "The larvæ of *Exyra Rolandiana* may be found in the smaller leaves of *Sarracenia purpurea* in this vicinity (Newton, Mass.) as soon as the snow is off the ground early in spring, apparently having moulted two or three times; they are then of a dull reddish brown and about 6 mm. long. As soon as the weather grows warmer, they increase in size rapidly, and, having eaten the leaf in which they have hibernated, betake themselves to the larger leaves, which they begin to eat after having made a hole near the base to let the water out and after having spun a close web over the mouth. The larva reaches its full growth about the first of May and later, when it is about 20mm. long, of a dull carmine or brown color, lighter, sometimes white, between the segments. The cocoon is spun in the leaf of loose white silk, the larva changing to a pupa a few days after spinning. The imago appears early in June. There is a good deal of variation in the color of the females, some being much brighter than others. The following are the extreme measurements of both sexes: males, 26-20mm., females 21-16mm. In its habits it resembles *E. semicrocea*, generally backing down towards the bottom of the leaf when disturbed, and using its wings in ascending. I notice that the frenulum at the base of the wings is very long in this species, and, as well as I could see, the moth seems to use it when crawling up the leaf. This species is very delicate and difficult to rear."

I have never found the larva at Ottawa before the beginning of June, and they had most of them at that time moved to a new leaf, but their presence on a plant was easily detected by the brown dead patch on the leaf where they had fed the year before and which showed plainly on the outside. The leaves containing the larvæ, moreover, as often as not, had some water in them. This, of course, may have resulted from the *débris* at the bottom having stopped up the hole observed by Mr. Thaxter. On one or two occasions when the larvæ were shaken off into the water, they floated on the top and easily regained their places on the sides of the pitcher. In all instances the surface of the leaf was eaten at one place only, generally near the top inside the leaf, the outside skin being left intact. The larva is sluggish and seldom moves from its feeding ground until full grown, when it spins a loose cocoon of very fine cobwebby silk, either against the side of the pitcher or, in two instances, beneath the surface of the mass of decomposed insects and its own excreta. The web over the mouth of the pitcher, although very fine, seems to keep out quite effectually all other insects after the leaf has been taken possession of by the larva. The time of appearance of this moth is rather extended. Moths have been taken here by the first week in June, and at the same time a very small larva was found which did not give the perfect insect until the 12th of July.

The following is a description of this caterpillar when full-grown: Length, when extended, three-quarters of an inch; spindle-shaped; distinctly segmented; general outline closely resembling the larva of *Xanthoptera semicrocea*, figured by Prof. Riley on page 208 of the *Canadian Entomologist*, vol. vi., but lacking the fleshy processes of the abdominal segments ; head and first segments small ; segments 2-7 gradually enlarging to 3 mm., and then tapering to the posterior extremity ; each segment velvety claret color, the velvety hairs only in the central part of the segments ; the intrasegmental sutures smooth, pale, in some specimens almost white ; head white, marked symmetrically on each side with three black marks, the uppermost almost round, the middle one crescent-shaped, and the lowest, above the ocelli, comma-shaped ; spiracles brown, ringed with black ; on each segment about six small black tubercles bearing slender tawny bristles ; thoracic feet and pro-legs darkened externally. When walking this caterpillar has the same half-looper appearance as the caterpillars of the *Plusias*, due to the fact that like them it has only two pairs of abdominal pro-legs. At the same time the fore part of the body is moved from side to side with a wavering motion.

Before spinning its cocoon the caterpillar ceases feeding for about a day and then spins its flimsy cocoon through which the chrysalis can be easily seen. The pupal stage lasts between 15 and 19 days. The moth when it emerges crawls up the sides of the pitcher and easily forces its way through the gossamer-like covering.

CATASTEGA ACERIELLA Clemens, SEMASIA SIGNATANA Clemens.

By The Rev. T. W. Fyles, South Quebec.

In my notes on "The Season of 1893," published in the Society's last Report, I described the Catastega larva and pupa. In telling of the habits of the larva I said, "Then it bites away portions of the inner skin of the leaf and proceeds to make itself a case" This, without addition may be somewhat misleading.—*It makes its case of its excrementa.* The larva vacates its case, or rather *tube*, and drops from the tree about the 15th of September. The perfect insect appears in the middle of April next ensuing. The following is a description of it :-

Length of body one-fourth of an inch. Expanse of wings five-eighths of an inch. Colors, grey and brown. Antennæ, filiform, grey ; palpi, large and pale grey ; face, clothed with long, pale grey, feathery scales ; eyes, protuberant, pale grey ; thorax, grey ; abdomen, brownish grey ; legs, feathered throughout, pale grey—the tarsi barred with brown on the upper side, as are also the tibiæ of the middle and foremost pairs ; primaries, pale grey, having numerous, dark-brown lines, running from the costa with a backward curve for about one-third of the width of the wing ; having also three conspicuous patches of dark brown, one—somewhat triangular—in the centre with an angle touching the costa, and one on each side of this, running from the inner margin about half-way across the wing—the base and outer angle of the wing are clouded with brown ; secondaries, brownish grey, darkening towards the hind margin ; fringes of all the wings grey.

On April 17th I sent specimens of the moth to Professor Fernald, and said :—"I dare say the moth is known under another name. If this be the case, which name will stand good ?" To this he very kindly replied. "I am in receipt of your letter enclosing specimens of *C. aceriella* Clem. which prove to be *Semasia signatana* Clem. and this last name will hold, because it was given to an imago which was properly described, and the type is still preserved in the collections of the Am. Ent. Soc. in Phil., and because the former name and description were for the early stages of some unknown insect."

NOTES ON A FEW CANADIAN COLEOPTERA.

By W. Hague Harrington, F.R.S.C., Ottawa.

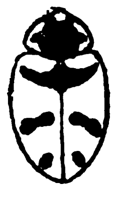


Fig. 31.

Hippodamia 5, signata, Kirby.—Fig. 31 (much enlarged) In the summer of 1893 I collected in a swampy meadow some coccinellids with the hope of obtaining hymenopterous parasites from them. In this I was not successful, but from a specimen of the species named there emerged two individuals of a small, white hair snake (Gordius ?) about two inches long.

Brachyacantha ursina, Fab. This beetle has been very abundant at Ottawa the past two seasons, although formerly I had only found occasional individuals. During July and August it occurred commonly upon milkweeds About the end of April last year, in examining colonies of ants under stones, I discovered in a colony of the small brown ant (*Lasius alienus*) four larvæ which were devouring plant-lice, which were feeding upon the roots of grass after having been wintered by the ants. These larvæ were whitish and powdery, like the aphides themselves, and were 6 mm. long and 2 mm. wide tapering only slightly toward the extremities. Recognizing them as coccinellid larvæ, I secured them and placed one in alcohol. The remaining three were kept in a small jar with a few of the aphides, but they did not appear to eat any more, and a day or two later had gathered in a group and formed for themselves almost globular cocoons of white flocculent secretions, in which they pupated. The imagos emerged between the 15th and 20th June, and proved to be *B. ursina*, whose larval habits have not been described so far as I can ascertain with the literature at hand.

Antherophagus ochraceus, Melsh. This beetle is found sparingly upon flowers, such as the spiked-maple, goldenrod, etc. On one occasion I observed a humble bee (*Bombus terricola*), upon a currant bush, and evidently in trouble. Closer observation showed that some small insect had seized her by the end of her tongue, and was retaining its hold in spite of the bee's frantic exertions to dislodge it with her front legs. I secured the bee in my cyanide bottle and when she was dead found that her assailant was still attached to her tongue, and was a specimen of *A. ochraceus*. They are still together in my cabinet. Dr. Riley has, I think, mentioned this species as occurring in the nests of Bombus, but I cannot find the reference at present. Had the beetle in this instance merely attached itself to the bee by accident, or was it intent on getting free transportation to the bee's nest ? If the latter were the case it probably intended to attach itself to the leg, and seized the tongue in mistake.

Oestodes tenuicollis, Rand. This rather pretty elater has been one of the beetles which I had always been expecting to turn up at Ottawa, but which I had never found until this summer, when several were taken upon goldenrods on an island below the city, and one also in a field in the suburbs.

Poecilonota cyanipes, Say. This fine little buprestid is rare, and only occasionally found upon willows and poplars, upon the former of which one specimen was taken during the past season.

Anthaxia aeneogaster, Lap., (*inornata*, Rand.) The habits of this pretty little species appear to be somewhat different to those of our other species of Anthaxia, which are generally obtained by beating trees during the summer, whereas this species usually is found earlier in the season, and nearly always on flowers, such as trilliums, etc. Three were taken on the 20th June last in the flowers of *Cypripedium pubescens*, the Yellow Ladies' Slipper.

Hydnocera difficilis, Lec. Last spring I collected a number of the small, round, flat spider nests, which may be commonly found adhering to stones. They are of a tough consistence, and somewhat glistening surface, but I do not know the name of the species which constructs them. They are frequently infested by a Pezomachus, the oblong cocoon of which can easily be seen when the spider's cocoon is held up to the light. From one of the cocoons which I supposed to contain a Pezomachus there came forth a beetle of this species. The hole cut by it was more irregular than the orifice by which the hymenopterous parasite issues, and exposed to view within the exuviæ of the beetle.

Cupes concolor, Westw. Some years ago I captured one of these beetles when beating shrubbery on the edge of a small lake, but it did not turn up again until this year, when one was found in my bed-room on the evening of July 28th. It had apparently flown in the window, attracted by the electric lamp.

Saperda lateralis, Fab. On June 24th I captured near Hull a beautiful example of this elegant longicorn. My only previous capture of the species was made with a paddle as I was crossing the Ottawa. My canoe was in mid-stream when I saw a rather uncommon looking beetle flying by, and I could just reach it with the paddle, to the wet surface of which it stuck; such are the accidental captures which do not throw much light on the localities to search for further specimens.

Chalmys polycocca, Lac. This beetle was more than usually abundant the past season, and did considerable damage to blackberries, the foliage of which was often so badly riddled as to be virtually destroyed. The beetle is readily recognized by its almost globular, bronzed and corrugated body, and the grubs can be easily found, as they live in black ob-conical cases which are quite conspicuous upon the riddled leaves and stems. A number of the larval cases were collected and kept in breeding jars with a hope of securing parasites, but only beetles were obtained. From one pupa case, however, there sprouted a small slightly club-shaped fungus about 4 mm. long.

Phyllodecta vulgatissima, Linn. This beetle occurred in great abundance upon willows on an island below the city, and during the months of July and August the beetles and their larvæ almost entirely destroyed the foliage of some low-growing species. The beetle had never previously been observed in such numbers near Ottawa.

Diabrotica longicornis, Say. This insect was described in 1824 from specimens found near the Rocky Mountains, and is a common species in several of the United States, especially in Illinois, Iowa and Missouri. It has been frequently a very serious pest to corn, in the roots of which the grubs burrow. A very complete account of its life-history and ravages may be found in a report by Prof. Forbes (10th Rept. of State Entomologist, Illinois), which contains good illustrations of the various life stages of the insect. I do not find that it has ever been recorded from Canada, nor can I find any mention of the northerly and easterly limit of its distribution. It will therefore, I think, be of considerable interest to record the occurrence of this pretty little greenish beetle at such a far easterly point as the head of the Bay of Fundy. On Sept. 8th, 1890, I found it quite abundantly on the Big Tantramah Marsh near Aulac, New Brunswick, which is almost on the boundary line between that province and Nova Scotia. It may be added that these and similar dyked lands are always spoken of as the "marsh." The beetles were found upon the flower-heads of the common large thistle (*Cnicus lanceolatus*), apparently feeding upon the pollen. Thirty or more were easily secured upon a small patch of the thistles. But little corn is grown in the neighborhood, nor am I aware of the occurrence there of ragweed, in which the beetle has also been stated to breed, and it seems probable that it must find a living in the roots of some of the larger grasses.

Nacerdes melanura, Linn. This beetle, introduced from Europe, is, according to Dr. Hamilton, rather rare in America. Some years ago I captured one on a wharf in Sydney, N.S., and on June 26th last I found another on a building in this city.

Corphyra Newmani, Lec. Four or five springs ago I noticed a curious behavior on the part of this beetle. Specimens were twice found mounted upon *Melöe niger*, but for what purpose was not apparent, unless they were attracted by the oil exuded by the blister-beetle. The specimen which I have in my cabinet is dated May 22nd. It is a male, as is also the Meloe upon which it was captured. The species is not uncommon here on flowers.

Melöe sps. ? Frequently when collecting hymenoptera I find upon some of the smaller bees, such as Halictus, the minute triungulin larvæ of Meloe. They generally are attached to the posterior femora or to the hairs at the base of the abdomen, and several are sometimes found on one bee. One day last season I saw what seemed to me a new species of bee with a red metathorax, but to my disappointment, when I had carefully netted it, I found it to be only the very common *Prosopis affinis*, upon which more than half a dozen of the triungulins had clustered, so as to entirely cover the metathorax. At least two species of these triungulins are common, one being yellowish, the other brownish. They occur most frequently on *Ceratina dupla* and *Halictus discus?* during the month of June. I have also found them upon the catkins of willows waiting for the visits of these bees, so as to be carried to their nests.

Barynotus Schœnherri, Zett. This European weevil, which I recorded in Vol. 23, p. 21, as occurring at Sydney, N. S., in 1884, was again found there by me last September, at a point some distance from the shore where I formerly took it. The specimen was also much fresher in appearance, and there can be no doubt that the species is definitely settled there.

Otiorhynchus sulcatus, Fab., and *Otiorhynchus ovatus*, Linn., also occur somewhat commonly at Sydney, but are very much less common than the next species to be mentioned.

Otiorhynchus rugifrons, Gyll. In a dry rocky pasture where I collected one morning, this beetle was found in great abundance. Under nearly every stone several would occur, either clinging to the under surface, or upon the roots of the grasses, etc. Great quantities of the ejectamenta of toads were seen, and the pellets were composed almost entirely of the remains of this beetle, with an occasional specimen of the preceding species. Thousands must have so perished, as fifty or more were required for one meal by the toad, and I imagine that even then he got very little nourishment, in proportion to the mass of indigestible matter swallowed.

Hypomolyx piceus, De G. This fine northern weevil does not appear in our label list, although under the synonyms *H. pinicola*, Couper, and *H. pineti*, Fab., it is recorded from several points in Canada. Last year I took a dead specimen in the leaf of a pitcher-plant some 30 miles from the city (near Casselman), but to-day (17th Nov.), in searching for *Staphylinus erythropterus* I found four fine fresh specimens at the base of a larch tree, just under the moss. From the condition of the beetles and their being all on the same tree, it seems evident that they had been bred in it; the only conifers near by were larches and cedars.

Conotrachelus anaglypticus, Say. This handsome little weevil was an addition to my Ottawa list this season; six specimens having been taken on goldenrods, upon the island previously mentioned, on August 18th and 25th.

FOOD, FEEDERS, AND FED.

BY REV. THOMAS W. FYLES, F.L.S., SOUTH QUEBEC.

On the cover of that interesting magazine "Science Gossip," are represented incidents in the feud that seems to have known no truce since the beginning of created things. A fish has made a spring from the water to catch a fly, but has itself been seized, at one end by a kingfisher and at the other by a pike. Underneath, a water-insect is making every effort to escape from a dytiscus, whilst a perch is in eager chase of the pursuer, unmindful of the monster that with open mouth is close at its own tail. The consummation of such a series of efforts is described in another publication, which, with half the title of that just mentioned, makes a larger claim, viz., "Science." Dr. Charles C. Abbott tells us that he found a bull-frog (*Rana Catesbyana*) with enormously distended sides, and that on examining the contents of its stomach, he found a garter-snake (*Eutama sirtalis*) eighteen inches long, and a field-mouse (*Arvicola riparia*). Close examination shewed that the snake was in the very act of swallowing the mouse when the bull-frog made a meal of both of them. SCIENCE, Vol. III, p. 67.

SNAKES.

I once saw a large garter-snake swallow a full-grown toad. This toad had held possession of a flower-bed in my garden. In it no doubt it had done me good service by catching various insect intruders. When I came upon the scene the snake held the toad by one of its hind legs. There was no attempt at resistance. The toad, charmed, or overcome by terror, quietly submitted, and the snake drew in both legs of its unfortunate prey as far as the haunches. At this stage of the proceedings, regardful of the toad's services, I interfered, and disturbed the snake by poking it with my walking-stick. It glided away; and I supposed, of course the toad would make off too. But no, it drew itself together and sat, as stolid as Mark Twain's celebrated frog. After a few minutes the snake came sidling back again. It rubbed its head on the ground, first on one side and then on the other, with the fawning motions of a kitten, and so approached the toad which remained apparently quite apathetic. It seized it by the hind legs as before. The gorging process went on smoothly until the trunk of the toad was reached—then came the strain! I could see the upper jaw of the snake cautiously raised and slightly protruded. Then fresh hold was taken, and the bite with effort secured. As this process was continued, the forward part of the toad's body was more and more distended with the displaced viscera and compressed air. By and by the fore-legs of the toad stuck out angularly, one on each side, and seemed to offer insurmountable difficulties—but no, they in turn were engulphed; and the last motion I saw of the unfortunate victim, as its face was drawn in, was a solemn wink, which seemed to say, "It's all right, my good Sir; it will be worse for the snake than for me. I'll give him a horrible fit of indigestion!" The whole process occupied exactly two hours. How long the toad would live in the snake's inside it is impossible to say. Two naturalists, out on a collecting tour, captured a snake a little more than a yard long, which had a peculiar lump in the middle. Whilst carrying the snake homeward by the tail, they noticed that the lump gradually approached the head. They hung the reptile to a tree still with its head downwards, and awaited developments. The mouth slowly opened, and a large toad covered with a greenish slime dropped out. After some minutes the toad recovéred, "and was seemingly little the worse for its imprisonment." SCIENCE GOSSIP, 1874, p. 68.

The snake is not always a conqueror, it is sometimes, as we have already seen, a victim. I have seen a pigeon-hawk (*Falco columbarius*) pounce down upon and fly off with a garter snake; and, stranger still, I have seen a hen shake out a red-bellied snake (*Storeria occipitomaculata*, Baird and Girard,) as one would snap a whip, and then gobble it up—beating back her chickens with her wings meanwhile. The air of complacency, befitting one who had done a virtuous action, with which she afterwards strutted off with her brood, was a thing to be remembered.

Besides the snakes above-mentioned we have in the province of Quebec two others that are frequently met with—the riband snake and the water snake, and two which seem to be local and rare—the milk snake and the grass snake.

The milk snake (*Coronella eximiens*, De Kay) is found on the hills bordering upon Vermont. I have taken it on Shufelt's Hill which overlooks the village of Sweetsburg. It is an exceedingly beautiful creature. Its body-color is fawn, softening down to white underneath. All along the back and sides are irregular blotches of rich warm brown bordered with very dark brown.

The grass snake (*Cyclophis vernalis*, De Kay) I have met with only in the neighborhood of Quebec. Two years ago I found a dead specimen in the road near the English Church at New Liverpool; and last summer I captured the living snake on the Island of Orleans. The circumstances of the capture were these: I had drawn down a branch of a young ash-tree to examine it for larvæ, and I was conscious of the fall of a rather heavy body. I glanced down, and at my feet was the snake just making off. I took it with my net, and examined it closely. It was about one foot eight inches long. In form it was very elegant; and its color was a delicate pea-green, without spots or markings of any sort. Underneath the hue was somewhat paler, much like that of the down on the body of the Luna moth. The eye of the snake was black, and its glance was as mild and innocent as that of a canary bird. While I was debating in my mind how I should carry it home—for I had no box with me large enough to hold it—it found a hole in the bottom of my net, escaped through it, and glided into a clump of young thorn-bushes and I saw it again no more. It frequents the trees to catch young birds and insects.

But it is when we come to interview the insect tribes that we find the most astounding series of gastronomical accommodations. One insect fattened upon another is destined to become food for a third, which in turn must fall a prey to a fourth. Consider the

SPIDERS.

We have been taught to look upon the spider as an embodiment of successful villany—of cold-blooded calculation. We hold in abhorrence its stealthy steps to entrap the innocent and unwary.

> "Will you walk into my parlor?
> Said the spider to the fly;
> 'Tis the prettiest little parlor
> That ever you did spy;
> You only have to pop your head
> Just inside of the door,
> And you'll see so many curious things
> You never saw before."

Oh, the old reprobate! How much satisfaction it affords us to think that the black-headed Tit (*Parus atricapellus*) and other birds snap up without hesitation this betrayer of the innocent. But birds are not the only avengers upon its footsteps. Numerous insects make it their prey. Even that monster spider *Mygale Hentzii* (Fig. 32) of California finds a Nemesis in the "Tarantula Killer," as it is called, the *Pompilus formosus* of Say. (See the "American Entomologist," Vol. I, p. 129).

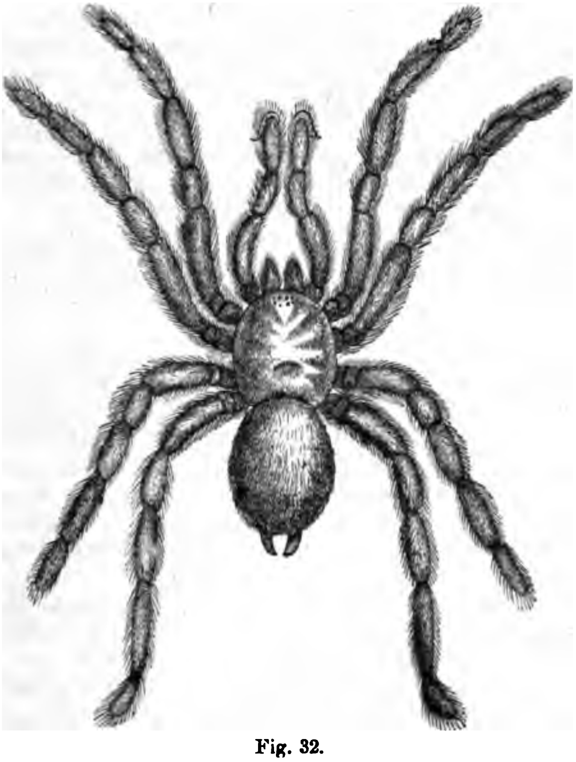


Fig. 32.

Some years ago I paid a visit to the Compton Ladies' College, which was then under the care of its public-spirited founder, the Rev. J. Dinzey and his excellent wife. I found in the cupola of the building a number of cells of a species of mud-daubing wasp, probably *Pelopœus cemetarius*, Linn. The insects had vacated their quarters, but there remained in the cells the skins of the spiders on which they, in their larval stage, had fed. Now nature abhors waste, and on these skins a number of small beetles of the species *Ptinus fur* Linn, were battening.

The mother mud wasp after building a cell crammed into it a number of spiders which she had paralyzed with her sting. Having provisioned her nest she laid an egg in it. The business of the larva that hatched from this egg was simply to make a long feast on the fresh food stored up for its use. But Walsh tells us that the larva is not in every case left undisturbed in this pleasing occupation. An ichneumon-fly (*Cryptus juncus*, Cress) sometimes pierces the wall of a cell and ejects an egg, the larva from which proceeds to dispose of the rightful occupant. Commenting upon this Walsh says: "Thus the spider preys upon flies, the mud-dauber upon the spider, and the ichneumon-fly upon the mud-dauber. 'Kill and be killed; eat and be eaten." This is the great universal law of nature." "American Entomologist," Vol. 1, p. 137.

I do not like to dismiss our friend *Ptinus fur* without further notice. He is small but he likes high living. He is a fellow of wonderful appetite! I think he outdoes in that respect the famous ostrich which indulged in ten-penny nails and broken bottles, or the African chief who despoiled a party of travellers of their supplies and was seen to eat up a pot of blister salve. It affects the dried specimens in our cabinets seasoned with oxalic acid and verdigris. Curtis found it eating an old coat; and it has been known to thrive on such gentle stimulants as *Nux vomica* and capsicums.

Not only are spiders exposed to dangers from without,—sometimes they suffer from "terrors within." The hair-snakes have been known to make use of them as hosts.

HAIR-SNAKES

are plentiful in the Province of Quebec. The most common of them is *Gordius varius.*

The Rev. E. A. W. King, of Waterville, obtained a worm ot this species, and placed it in a dish of water, that he might observe its motions. In a short time it commenced to lay its eggs. They were in the form of a white thread, many inches long, which was gathered into a loose tangle, and through and about which the worm entwined itself, as if to hold it in safety. He did not wait for the eggs to separate and hatch, but consigned the string and the mother worm to a bottle of alcohol.

I have obtained a male *Gordius* from a larva of *Zaræa Americana*, and a White Hair-snake 10 inches long from a Lepidopterous larva, that in length, was but an inch and a quarter. The creature lay closely curled—like the spring of a bird-trap—under the skin of its victim.

Hair-snakes are often met with in strange places. A lady in Montreal, feeling thirsty in the night, took a glass and filled it from a tap in the bath-room. While drinking she felt a tingling sensation on her lip. She paused—struck a light—and to her disgust found one of these creatures in the tumbler. (Moral: Look before you drink).

I lately heard an advanced version of the old myth of the horse-hair in the water. A gentlemen accompanied a hunter on an excursion in search of moose. The hunter looked carefully into every stream they came to, and, at length, discovering Gordii, exclaimed joyfully, "Yes, moose have been here—here are hairs from them turned into snakes."

The history of the hair-snake is not yet completed. The adult worm—its form and structure—its nervous, muscular and reproductive systems, have been fully described. Its mouth is said to open upon a gullet which spreads out upon the upper end of the cellular tissue which extends through the whole length of the worm (Dr. Meissner, quoted by Dr. Leidy, "American Entomologist," Vol. II, p. 195.) Its food, which has (it should be remembered) already gone through the digestive organs of its host, is passed "by endosmosis from cell to cell" and is completely assimilated.

The eggs, the embryos, and the newly developed Gordii have all been described. The last have been seen to enter the bodies of the larvæ of Ephemera, and have been found in them *encysted.* But, between the notice of them in that condition and the record of the perfect worm, there is a gap in the history. It remains for some careful Helminthologist to fill up the hiatus. It is believed that the Gordius is one of those creatures that have to pass from one host to another (like the Trichinæ) before they can reach their perfect state. We can understand how it could pass in the May-fly to predacious insects, such as the spider and the ground-beetle, but not so readily how it could find a second host in a a vegetable devourer, such as the locust or the caterpillar. It may be that the encysted worm is cast off with the pseud-imago skin of the fly, or that it survives the decay of the fly itself, and, being caught in the herbage, is taken in by some hungry herbivorous insect. The chances against it, in this case, seem to be very great. Still, when we remember the vast number of eggs laid by one female Gordius—they have been estimated at more than six millions and a half—we must allow that there is a very broad margin for failures; and that if only a small percentage of the brood arrives at perfection, there must be a very great number, indeed, of hair-snakes that run the full length of days allotted to their kind. In the case of the tape-worm, *Tœnia solium*, we know that the ova survive the decomposition of the ejected proglottides or divisions of the worm, and are swallowed by hogs and sheep as they feed upon the vegetation.

Another kind of creatures that affords us much food for reflection is the

APHIDES.

One day in July of this year I found two patches of these "plant-lice" on the broad Windsor beans growing in my garden. My first impulse was to destroy the intruding insects, but entomological curiosity overcame horticultural prudence, and I made up my mind to allow the insects to run their course. By the end of August there was not a stalk in the double row of beans (which was 12 yards long) that was not black with aphides. The insects clustered especially on the topmost leaves, and among the flowers, and along the edges of the pods. The winged brood of the species appeared in the middle of September.

The number of familiars and foes that resorted to this colony of aphides was truly amazing. First there were the ants busy about their "milch cows"—as the old naturalists called them. It was amusing to see a cunning ant approach an aphis and caress her daintily till she—either indignant at the liberties taken with her, or tickled to death with the fun—ejected the precious drops that the ant was longing for—for the love of the ant for the Aphis is simply cupboard love.

At least four kinds of lady-birds employed themselves in lessening the numbers of the aphides:—The Thirteen spotted, Fig. 33, (*Hippodamia tredecim-punctata* Linn,) the nine-spotted, Fig. 34, the beetle, fig. 35 larva, (*Cocinella novem-notata*, Kirby,) the five-spotted, fig. 36, (much magnified,) (*C. quinque-notata*, Kirby,) and the two-spotted, (*Adalia bipunctata*, Linn.) The handsome larvæ of these species might be seen driving their snouts into the ill-fated aphides, and after a while casting them off "flaccid and drained." The coccinellidæ are among the gardener's most useful insect friends, but they are not always duly appreciated. A gentleman saw a gardener busily employed in picking off the Lady-birds from his plants and treading them under foot. "What are you doing that for ?" he asked. "Well, sir," was the reply, "you see these nasty red things—them's the old uns; you see these little green things—them's the young uns just batched. I'm killing the old uns fust, and I'll tackle the young uns arterwards."

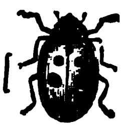


Fig. 33.

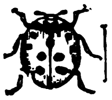


Fig. 34.

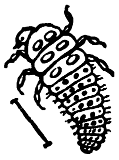


Fig. 35.

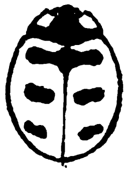


Fig. 36.

Attracted, by the aphides, and the honey-dew which they ejected, innumerable two-winged flies buzzed daily about my beans. On one occasion I counted fifteen different sorts. Conspicuous amongst them were, *Eristalis tenax*, Linn, the Drone Fly (so called from its resemblance to the male of the honey bee); a pretty black and yellow Syrphus Fly, *Eristalis transversus*, Wiedeman; *Volucella erecta*, Walker, easily distinguished by the brown patch in its wings; *Tachina vivida*, Harris, a bustling showy insect with a large orange-red abdomen set with black bristles; the Flesh Fly, *Sarcophaga carnaria* Linn, Fig. 37, (highly magnified,) large, red-eyed, with striped thorax and mottled abdomen—grey and black; the Green-bottle Fly, *Musca Cœsar*, Linn; the Blue-bottle Fly. *M. vomitoria* Linn, and a species of *Scatophaga*.

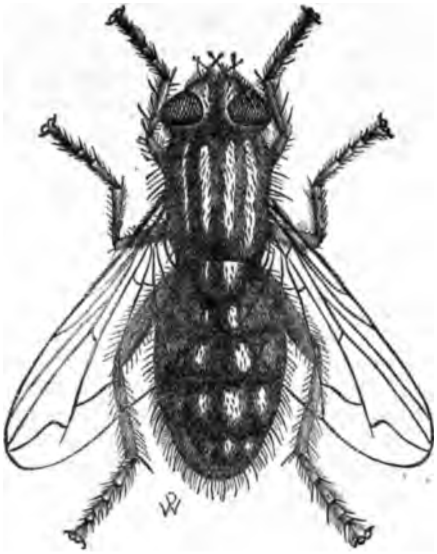


Fig. 37.

Less abundant as regards individuals, but more numerous in point of species were the Hymenopterous insects that frequented that row of beans. The following is a list of twenty different kinds of them captured during the month of September with the cyanide bottle only:

Ædynerus tigris, Saussure.
Philanthus bilunatus, Say.
Crabro singularis, Pack.
Monedula ventralis, Say.
Aphilanthrops frigidus, Smith.
Pompilus atrox, Dahlbom.
Hedychrum violaceum, Lepell.
Ichneumon comes, Cresson.
I. lœtus, Brulle.
I. flavizonatus, Cress.
I. jucundus, Brulle.
I. creperus, Cress.
I. paratus, Say.
Trogus Copei, Cress.
Amblyteles indistinctus, Prov.
Opion purgatum, Say.
Opheletes glaucopterus, Linn.
Bassus leatatorius, Fab.
Pimpla pedalis, Cress.
Sampronota Americana. Cress.

A few words on

Internal Parasites.

The lowest types of these with which we are acquainted are the Gregarinidæ which are found in earth worms and other annulids. The gregarina of the earth-worm consists of a transparent capsule filled with a colorless, semi-fluid, granulated mass, in one part of which a well-defined nucleus appears. The creature has no digestive apparatus—it lives by absorption of fluids through the capsule. When two

Gregarinæ meet they adhere one to the other, and then surround themselves with a cyst. The partition between them disappears; the nuclei also disappear and then the case becomes filled with spindle-shaped bodies called "pseudonavicellæ," which in due time escape from the cyst into the surrounding medium. Their after history is not yet told.

It is said that when a gregarina finds itself left in a state of single blessedness it does not give itself over to despair, but proceeds to encyst itself, and to produce pseudonavicellæ on its own account.

The internal insect-parasites of insects are of two kinds: (1) Those that complete their metamorphoses within their victims; and (2) Those that leave their hosts on the completion of the larval stage.

Of the former, *Rhogus intermedius*, Cress, affords us an example. It assails the larvæ of *Apatela hastulifera* Abbot and Smith, which feeds upon the alder *Aldus incana*, Willdenow.

The parasitized Apatela larva may be found in the autumn attached to the leaves and stems of the plant. In them the ichneumon grubs, having attained their growth, form their thin, brown, closely-woven cocoons, which are arranged at an angle of about forty-five degrees, and usually in four rows. I have drawn out with a setting-needle no less than thirty-five pupæ from one caterpillar. They were all placed with the head upward. Very regular rows of round holes show how the adult ichneumons escape from their nurseries. As I have found the flies at large in the middle of October I presume that some of them, at any rate, pass the winter in the perfect state.

There are much larger insects that undergo all their changes within their hosts such as *Ophion macrurum*, Linn, Fig 38, in the Saturniadæ, *Opheletes glaucopterus*, Linn, in Cimbex. The eggs of these are laid singly or in pairs.

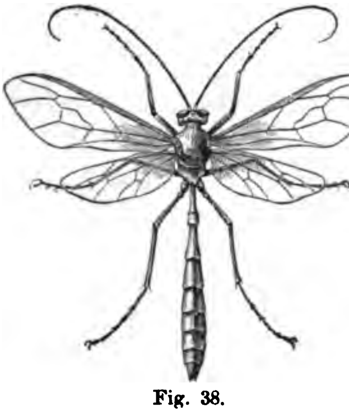


Fig. 38.

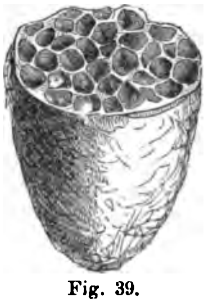


Fig. 39.

Of parasites that leave their hosts when full fed and before undergoing the pupal change *Apanteles longicornus*, Prov, is an example. The fluffy, yellow masses of the cocoons of this species may often be seen attached to the remains of noctuid larvæ, under the rails of fences, etc.

What entomological neophyte has not experienced the disappointment of finding, on a sudden, a carefully tended Sphinx caterpillar in a state of collapse, and bristling with the larvæ of some microgaster, that have extruded themselves from it, and that proceed to spin their cocoons about its remains.

But surely the most economical of all the internal insect parasites is the well-known *Cryptus extrematus*, Cress. The larvæ of this insect find themselves, they know not how, in the inside of a caterpillar of *Platysamia Cecropia*, Linn, and forthwith commence the herculean task of reversing the state of things in which they find themselves, and of environing their environment—putting the outside grub into their insides—beginning with the fatty portions of it. Numbers and perseverance accomplish the task, but not before the caterpillar has spun its wonderful cocoon. When this is finished the Cryptus larvæ, finding no more fat in preparation, hold a grand carnival on the vitals and frame of their host, and then spin their own cocoons within the snug winter quarters prepared by their unhappy victim. In them they lie through the winter as snugly packed, Fig. 39, as herrings in a barrel or sardines in a box.

CANNIBALS.

Among insect feeders upon insects the "Cannibals" must not be passed by. Of English caterpillars that have a bad reputation as such, *Thyatira derasa*, *Characlea Delphinii* and *Cosmia trapezina* are well-known examples. With *Mantis Carolina* Linn, the nuptial embrace has been known to end in the death grip, and the female to make a wedding breakfast of her spouse.

But the most startling story of all was told by J. F. Stephens, author of "Illustrations of British Entomology." He said that having turned the tail of a dragon-fly round to the head he saw the insect make a meal of four joints of its own abdomen. (See *Ent. Mag.* 1., p. 518). If this story had not come from so good a source, we should have thought it of like kind to that told of the Irishman, who, having disturbed a mud-turtle, "saw the baste swallow its own head."

There remains one other sort of devourers of insects that I wish to notice before concluding my paper—it is

FUNGI.

We are accustomed to the idea of insects feeding upon vegetables, but that of vegetables feeding upon insects is not so familiar to us.

A fungus that has excited much interest amongst naturalists is the *Sphœria Robertsiana*, which grows in, and out from, the caterpillar of a New Zealand Ghost-moth, *Hepialus virescens*. This caterpillar undergoes its pupal change in the soil. But it often happens that a spore from the Sphœria finds a lodgment upon the body of a Hepialus caterpillar—usually between the head and the segment following—and, vegetating there, penetrates to the creature's inside. The animal contents of the caterpillar are by degrees exhausted by the fungus, and the skin—which retains its perfect form—becomes filled with vegetable tissues. At the same time one or more sprouts from the fungus rise through the soil, and into the open air. Fig 40. The sporules are formed round the top of this shoot, which is sometimes ten inches long. The parasitized larva is called by the Maories "Hotete." It is sought for by them and greedily eaten. It is said to have a nutty taste.

There is a fungus of somewhat similar habits that affects the larvæ of the May-beetle, *Lachnosterna fusca*, Fröhl. It is found at Quebec.

In my paper entitled "A Day in the Woods," published in the Society's twenty-first Report, I told of a fungus *Entomophtora grylli* var. *aulica*, Fres, that was destroying the caterpillars of Arctians of different kinds. This fungus is still destructive. It affects particularly the larvæ of *Leucarctia Acrœa* Drury and *Spilosōma Virginica*, Fabr.

It may be that our meadows have been preserved from depredations, such as those described by Harris, under the head of "The Salt Marsh Caterpillar,"—("Insects Injurious to Vegetation," p. 351), by the agency of this fungus.

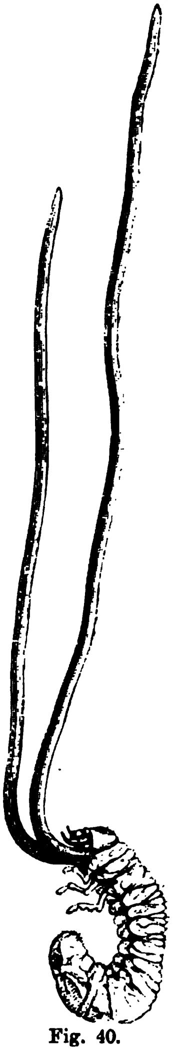


Fig. 40.

Time would fail to do justice to my theme—a volume might be written on every division of it; but I trust that I have said enough to awaken interest, and to stimulate research.

AN ATTACK OF EPHESTIA INTERPUNCTELLA.

BY H. A. STEVENSON, LONDON.

Attack.—Slender white or pinkish cylindrical caterpillars from one-half to three-quarter inches in length, with reddish-brown heads; a dark brown stripe runs along the side. The caterpillars were found feeding on raisins, prunes, rice, currants, dried apples, and wherever found they could be traced by whitish silk threads or webs. The caterpillars, when full-grown, spin close whitish or greyish-white cocoons about a half-inch long and one-sixteenth of an inch in diameter. When the caterpillars emerge from the cocoons they are a narrow rolled-up-like moth, and are a brownish-grey color with a golden lustre. A more complete report of this insect is contained on page 77 of Mr. Fletcher's report in the Experimental Farm Reports for the year 1889.

On August 17th I was called to a wholesale warehouse in this city (London), where they said they were troubled for the last three days with a small moth, which was increasing very rapidly. When I went down there these small moths were flying all over the warehouse in great abundance, from the cellar to attic; they were even on the outside of the front door, and they had originally started at the back door. I asked them where they came from, and they replied that they did not know where they came from, as the first were observed only three days before, so, after looking over the place I came across a shipment of Sultana raisins behind the back door and alongside the elevator. There were about 500 boxes, and the boxes were almost covered with the caterpillars and the moths. The moths were flying about in great abundance. A great number of the caterpillars had fallen down the elevator into the cellar, and some had also climbed up the supports of the elevator into the upper stories. The caterpillars had also penetrated into the adjoining rooms, and were swarming over the tea chests in great numbers —in fact, were into everything.

The raisins had been imported from Smyrna by Liverpool and Montreal, on October 20th, 1893, and had remained in the warehouse since then.

In three days from the time they were first noticed they had swarmed all over the warehouse.

Remedies—I recommended that the raisins and the tea chests, which were swarming with the caterpillars and moths should be placed in some large boxes which were air-tight, and in which some bisulphide of carbon had been exposed in open dishes and left for a time. The moths and caterpillars on the tea chests soon fell off, as they had not penetrated into the interior. But the raisins were left over night in the boxes and the pests were soon destroyed. The firm tried spraying the place with the bisulphide, but it dissolved all the rubber atomizers used.

At night some bisulphide of carbon was exposed through the different parts of the warehouse, and the proprietor collected the keys from the different employees and cautioned them about the use of lights, as the bisulphide of carbon is very inflammable, and the whole warehouse was swept thoroughly through with a good stiff broom.

The raisins were unpacked and picked over and thoroughly cleaned and reboxed again as good as new. I have been in the warehouse several times since, and have not noticed the recurrence of the insect.

Thanks are due to Mr. Moffat, who at once identified the insect and compared it with the specimens in the Society's collection. And thanks are also due to Mr. J. Fletcher, of Ottawa, to whom specimens were sent, which he identified as Ephestia interpunctella, and also for his immediate reply concerning the destruction of the pest.

THE ECONOMIC VALUE OF PARASITISM.

By F. M. Webster.

In the term parasitism, as here used, is included the preying of one organism upon another, whereby the latter is largely kept within normal, numerical bounds, or is reduced to such conditions when it rises beyond them. Or, in other words, the preying of certain so-called beneficial insects upon others called destructive, and the action of fungoid growths upon such destructive species. Parasitism, in its broadest sense, has been aptly termed the balance wheel of nature, because of its similarity in effect to the mechanical contrivance bearing that name, which is instrumental in equalizing the irregularities of motion, in the machinery of which it is a part, and hence dependant upon the same source for its motive power.

The effect of vegetable devouring insects is to prevent the encroaching of one vegetable upon another, lest the latter should be exterminated : and the insect and fungoid enemies of such vegetable-feeding insects prey upon them in order that they do not themselves carry their work to such an extent as to exterminate the plant they are only designed to restrict. Thus we have a plant being fed upon by a species of insect, which insect is being kept from exterminating this plant by its own or primary parasites, and these in turn are kept from destroying all of the plant-feeding insects by still other parasites, known as secondary parasites, and these also have their parasites, known as tertiary parasites, and besides are more or less influenced by meteorological environment. To make the matter still clearer, it is as if a number of men were sent to prune an orchard, and a superintendent sent with them to see that the task was not over-done, he too, being amenable to still other authority.

Now, both plants and insects are capable of reproducing far beyond the number of young ordinarily required to keep these elements in equilibrium ; but when, from any cause, one of them becomes abnormally reduced, this reserve reproductive force is brought into play, and the weakened element is thus soon able to regain its normal numerical power, but is restrained from going beyond. We thus have a huge piece of natural mechanism, self-regulating and self-adjusting, the balance wheel of which is parasitism.

Under perfectly natural conditions and uninfluenced by man, all of these natural organisms work in unison, as above indicated, and a temporary disarrangement of any one element, due to outside causes, such as the weather, is soon readjusted with little more disturbance to the others than would result to the Gulf of Mexico from the dropping of a pebble into the middle of the Atlantic ocean. In some cases a few plants might be killed throughout the local areas, but these would soon be replaced by others. But the husbandman now appears and upsets this equilibrium by destroying hundreds of species of plants over an area of millions of acres, and in their stead replacing but one. He causes a thousand apple trees to grow where nature intended but ten should exist. He causes the ground to produce a thousand grain plants, where nature intended but one to grow, and to produce seed far in excess of nature's requirements. The result is that the insect enemies of these cultivated plants, or such insects as can feed upon them, are greatly increased in numbers, because more of the young find a sufficient amount of food to develop them, and because they are needed by nature to counteract the influence of man. Later, the parasites, both primary, secondary and tertiary, increase for precisely similar reasons, and in obedience to the same laws, though, of course, they follow more or less distantly the movements of their hosts. From the fact that their movements do follow more or less distantly the ebb and flow of their respective hosts, the question of the economic importance of their influence has remained unsettled, and, by some, has even been doubted. When we come to consider that but an exceedingly small percentage of the movements of these insects ever reaches the eyes of even the most observing entomologist, and of the interactions of these organisms we really know but very little, it will be observed that to estimate the economic value of their influences is a very difficult task, if one expects to be just and secure the actual facts. A millionaire, in one of our larger cities, may replenish his purse at the bank each morning and go about among the poor, supplying to the needy a coat here, a pair of shoes there, a breakfast in one place and a supper in another; medicine for one sick mortal and medical attention for another; and go on in this way for years without being known outside of his own city, especially if he does not choose to advertise his generosity. But let him once fall into the clutches of a dissolute woman whom he may have, out of pity, befriended, and he will be publicly introduced from one side of the continent to the other, and the student of human nature will, indeed, have to be exceedingly guarded in his conclusions if he expects to get an unbiased estimate of this man's character, based only on the facts thus placed in his possession. Yet it seems to me that he is in as proper position to do so, as is even the working entomologist to pass upon the value of parasites in overcoming an invasion before more or less financial loss has accrued, basing his judgment upon the failures to do so that have come under his observation, and necessarily leaving what he does not see out of consideration. I do not believe anyone, be he ever so good an observer, can, within the space of one life time, collect data sufficient upon which to base the statement that " they usually appear in force only after the damage is done." Twenty years of close observation of insects, in the fields, leads me to make this statement; and I venture to say that in ninety-nine cases out of one hundred, an invasion of an injurious insect will attract the attention of an ordinary entomologist only when its parasites fail to overcome it before it has caused monetary loss. If the entomologist does not see them, how much more likely is the ordinary farmer to note these conflicts between parasites and hosts? It is the failures that usually first attract our attention, while the successes are more often unobserved, and, such being the case, how can we, with justice, weigh evidence we do not possess, and of the magnitude of which we can have little conception.

Now, I will give a few personal observations relative to this matter, which illustrate the fact that thousands of similar cases might pass unnoticed, even by those possessing fair abilities for seeing such things.

Ten years ago, in Indiana, I was studying wheat insects, and found the Wheat Midge larvæ, *Diplosis tritici*, exceedingly abundant in a number of fields; enough so to threaten serious injury to the crop. Soon after I observed these, considerable numbers of *Coccinellidæ* and *Telephoridæ* were running about over the heads of the wheat, thrusting their own heads down among the bracts, and feeding among the maggots of the *Diplosis*. Some of the *Telephoridæ* were venturesome enough to thrust their heads among the bracts in order to secure such of their prey as were exposed by the bending of the head as it swayed in the wind and were caught by the wheat head suddenly returning to an upright position, and if a breeze did not soon release them, paid the penalty of their temerity with their lives. Thousand of these carnivorous beetles were present, and they must have destroyed millions of the *Diplosis* larvæ, in the ten days to two weeks they were observed at work, and no perceivable injury resulted from the invasion of the midge.

A few years later a couple of coniferous trees on the campus of a western University were attacked by a scale insect, *Mytilaspis pinifoliæ*, if I recollect correctly, and by midsummer the leaves had a decidedly whitish tinge, as if sprayed with a dilute whitewash, and besides, took on a sickly look. In the meantime a colony of *Chilocorus bivulnerus*, or Twice Stabbed Lady Beetles, (Fig. 41), as they are commonly called, took up their abode on the trees, deposited their eggs and with the larvæ from these (Fig. 42) began to destroy the scales. All through the autumn the contest was waged, and with the coming of cold weather all the beetles, which had long before escaped from their pupa cases, went into winter quarters. With the coming of spring they were observed to return to the trees, and again began the contest in turn giving way to their larvæ, and these emerging as adults. In early summer the ends of the branches began to show leaves free from scales, and by the coming of winter again the outbreak of the pest had apparently been entirely overcome, and the fall rains washed off all vestige of the conquered hosts. The invasion had been overcome, and I doubt if another person besides myself had been aware of the two years' conflict.

Later, the maples along one of the principal residence avenues of Columbus, Ohio, were threatened with an invasion of the Maple Bark Louse, *Pulvinaria innumerabilis*, (Fig. 43), and the trees would certainly have been overrun the following year, had not this same Lady Beetle appeared in numbers, and with their larvæ so reduced the pest in numbers as to render injury impossible.

The appearance of the Grain Aphis, *Siphonophora avenae*, in such enormous numbers, during some seasons and the almost total absence of them during others, are matters of continued observation, but the causes therefor are not well understood. The present season, there was, quite early, indication of an outbreak of this species, but later it largely disappeared, while the cause for its doing so is obscure. Now, with all the light on the subject that I have been able to gain from several years' study of this insect, I am about convinced that the secret lies in the condition of the weather during spring; that cold, wet weather, at that season retards the development of their Hymenopterous parasites, by which they are largely held in check, but does not retard their own development to the same extent, thus giving them an advantage, early in the season, which is sometimes not overcome until much later and after the aphis has worked some injury. One other observation and I am done, though if space would allow, and time permitted me to go over my note books, I could multiply the number by at least fifty.

Fig. 41.

Fig. 42.

Fig. 43.

Late in April and early in May of the present year, there was considerable consternation among the farmers over a large portion of the State of Ohio, caused by the appearance of enormous numbers of the larvæ of the Clover Leaf Weevil, *Phytonomus punctatus*, in the clover fields. These larvæ were literally swarming and eating the plants to the ground, which, together with the drouth prevailing at the time over the northern portion of the State, gave matters anything but a favorable appearance, and it seemed that many fields could not escape ruin. In fact, an occasional farmer was frightened into plowing up his fields. But just here a fungous disease, *Entomophthora sphaerosperma*, Fresn., appeared and the effect was astounding. Farmers who had about given up all hope of a hay crop, wrote to say that the worms were all dead or dying and they could not find a live one. One farmer, who came in to consult me about breaking up his field, came a few days later to say that all the worms were dead or dying, and I found a close search was necessary to fine a healthy one of any size, and but few of even the youngest. Now, I do not believe a million dollars would cover the saving to the hay crop of Ohio, by this minute fungus, the present year. But this is not all. Soon after, rains occurred and the effect of the worms resulted only in retarding the blooming of the clover, precisely the effect of mowing or pasturing when done to prevent the depredations of the Clover-seed Midge, *Cecidomyia leguminicola*, and whether the result was the same or not, the farmers over the area covered by this Leaf Weevil, harvested a good crop of clover seed.

As previously stated, I do not even pretend to have observed a one-thousandth part of similar instances that have been going on in every locality each year. And I repeat again, it is the cases where parasites fail to overcome a destructive insect, before it occasions financial loss, that are the exceptional ones, and the nature of these failures is such that we see and recognize them far more readily then where the reverse is the case. It is the damage that we see, and this being the case, how can we see it before it exists? Not only this, but I believe the great fundamental principle involved in the use of insecticides is to assist parasites in doing their work; and as we get to applying them more and more intelligently, we shall watch for the exceptional cases where parasites are weak in numbers, and by artificial methods, seek to offer a substitute for the lack of numerical strength.

A RE-APPEARANCE OF PIERIS PROTODICE BOISD.

By J. Alston Moffat, London, Ont.

On the 18th day of October, 1894, I received a *P. protodice* from Mr. C. Anderson, a young collector of London, who has done some excellent work during the past summer, by sugaring in his father's garden. A few days previously he had called on me to say that he had seen on the street a white butterfly that was new to him. Failing to recognize his description of it, I showed him the drawer containing the *Pieris*, when he at once pointed to the female of *protodice* (see fig. 15) as like what he had seen. I gave him some information about the peculiar history of that butterfly which excited his interest, and he determined to make an effort to obtain some of them. With that end in view, he went on the 17th to a locality which he thought was the one most likely for them to be found in, with the result that he secured a pair of them, and when he showed them to me on the 18th they were yet alive. This is the first living pair of that butterfly that I have seen since the autumn of 1872, when *Pieris rapae*, the imported cabbage butterfly appeared on the stage to act its part, whilst the native one retired from view.

In 1887, Mr. S. H. Scudder, of Boston, published a most interesting account of the introduction and spread of *Pieris rapæ* from 1860, the year in which Mr. Couper captured a few specimens at Quebec, where it is supposed to have been landed, and the first reported to have been seen on this continent, to 1886, when it had reached the Rocky Mountains. This history of the introduction and spread of *P. rapæ* is full of interest and importance to the cultivators of some of the most valuable products of the field and garden; but the fact, that as the imported *rapae* advanced the native *protodice* disappeared, has ever seemed to me to be one of the most singular and interesting events in natural history that has come under my observation.

I have seen the statement made by various writers, that *Pieris oleracea*, also native, has disappeared from their locality on the advent of *rapæ*. This does not accord with my experience. *Oleracea* I always found to be confined to certain locations, periodical in its appearance and never very plentiful; and so it has continued to be. But *protodice* used to be more or less abundant every autumn until *rapæ* came, when it totally disappeared from my field of observation.

Mr. Scudder in tracing *rapæ's* gradual spread westward, says: "In 1873, as before stated, it reached Port Hope, and 'F. C. L.' reports taking his first specimen at Dunn in Haldimand county, Ontario, (Can. Ent. vi. 60), and some were taken at Hamilton (J. A. Moffat), where one would have looked for it the preceding year from its presence then at Toronto."

I have always felt quite certain that *rapæ* was present at Hamilton during the fall of 1872, although I did not notice it. My attention was arrested that season by the unusual abundance of cabbage butterflies, which I set down without examination as *protodice.* Not being informed about the advance of *rapæ*, I did not suspect its presence until the following winter, when upon a visit to Dundas I saw specimens of it in Mr. Kyle's collection which he had captured in his own garden the previous summer without suspecting that they were other than a variation of the native *protodice.* So that if I had examined closely, I have not the slightest doubt but I would have found *rapæ* helping to swell the numbers that so attracted my attention during the autumn collecting; confirming Mr. Scudder's expectations. Moreover, I found *rapæ* in the spring of 1873, indicating that it must have been present the previous fall. From that onward, I saw no more *protodice*, their place being taken by *rapæ*. And this I believe corresponds with the experience of Canadian collectors.

I have never seen this sudden and total disappearance of *Pieris protodice* satisfactorily accounted for. When I have seen the subject touched upon, it has usually been dismissed with a reference to "the struggle for existence and the survival of the fittest," which does not seem to me to apply in this case at all. The breeding habits of the two differ considerably; the native *protodice* was quite content to make use of the natural products of the soil for its purpose, whilst the imported *rapæ* attacks first, and in preference to all others the cultivated ones. So there need have been no "struggle" between the two on that point, as there was plenty for both, and as the larvæ of *rapæ* had an abundance of vegetable food to its liking, it would not devour that of the other even if it had met with it on the same plant. As that theory does not account for the disappearance of *protodice*, I have to look for one that will meet the requirements of the case.

It is a well-known principle in biology, that there are races of animals of the same species, that are possessed of different constitutions and dispositions, and that there are in nature, external influences at work which, acting upon the living organism will produce such differences. That in some instances, such differences manifest themselves geographically, and are spoken of as geologic and climatic, or as pertaining to the soil and climate. That races may differ in strength of constitution and character according to the part of the globe to which they belong. And that a strong race commingling with a feeble one, will impress its peculiarities upon the results of such a union and make its controlling power manifest.

Now it is generally admitted, that the life of Europe is of a more vigorous, tenacious and aggressive character than that indigenous to this continent; therefore I come to the conclusion that *protodice* and *rapæ* are but different races of the one species, and that when they met and commingled, the stronger constitution and proclivities of *rapæ* prevailed, and the outcome of the union were all stamped unmistakably *rapæ*, the characteristics of *protodice* being completely absorbed and obliterated. This seems to me to be quite sufficient to satisfactorily account for all that has occurred in connection with these two butterflies, and if it is correct then the probabality amounts almost to a certainty, that, sooner or later *protodice* will return. This is not a prophecy, but a simple deduction from the well-known laws of nature; for the external influences that produced the typical *protodice* and brought it into harmony with its environment at first are still at work, and working in the same direction. Therefore, when these external influences have had sufficient time to work their utmost upon *rapæ*, and no fresh importations take place, a reversion to the original type will be brought about as a matter of course.

In seasons of its greatest abundance, *protodice* never caused any serious injury to cabbage, in this northern portion of the continent at least. Its larva was quite content to feed upon the loose outside leaves of the plants, and so did but little harm; but the larvæ of *rapæ* will eat their way into the solid heart of the largest heads, injuring them greatly, if not ruining them utterly. If then *protodice* should return with its original disposition unimpaired and supplant *rapæ*, it will be a welcome transformation to the cultivators of that useful vegetable.

REMARKS ON THE STRUCTURE OF THE UNDEVELOPED WINGS OF THE SATURNIIDÆ.

By J. Alston Moffat.

I have had an opportunity of making further microscopical examination into the condition of the undeveloped wings of one of the large Saturniidæ.

During the winter of 1893 and 1894, I secured a large number of the cocoons of *Attacus promethea* and *Telea polyphemus.* In the early spring of 1894 I watched them closely, so as to secure, if possible, some of the moths on their escape from the cocoon, before expansion had commenced.

I was fortunate on being present at the moment of emergence of a fine large specimen of *T. polyphemus,* which I killed at once before growth had started. After removing the front winglet from its socket in the thorax, I found that the crimpling of the heavy nervures on the costal margin had relaxed, yet, even with that addition to its size, it measured only five-eighths of an inch in length and about three-eighths at its widest part; which might have expanded to three and a half inches in length, and one and a half at its widest part.

I did not discover anything new about the structure of the nervures, but I paid especial attention to them in relation to some suggestions that were made in connection with my former observations, to see how far they might be correct or otherwise.

One was, that the nervures might be constructed spirally, and that the extension of the membrane of the wing might be produced by, as it were, the relaxing of a compressed spring. I could see nothing to confirm such a view. The prominent rings of each segment made a complete circle. The extension of the nervure is in a straight line, something after the manner of the drawing out of a telescope, only, the one section not merely draws out of the other, but the small end of the one section draws out with it the inside of the large end, and keeps on extending until the nervure is all brought to a uniform thickness, with a slight reduction to the outer end.

It has been claimed by some, that the fluid enters the nervures and assists in the extension of the membrane. This, I am satisfied, is not the case. I examined the large nervures of an expanded wing, and found some parts of them hollow, and quite empty, which would not have been so if fluid had entered them. Moreover, the parts of the nervures where the segments unite seem to be solid, somewhat resembling the joints of a bamboo-cane, which would make the passing of the fluid through them almost, if not quite, impossible. My impression is, that the nervures do not in any measure contribute toward the extension of the wing, but depend for their own extension upon the pressure derived from the fluid flowing between the membranes.

The amount of fluid stored up in a newly emerged imago to be used in expanding the wing, must be very great. One of my *A. cecropia* in coming out of the cocoon, had in some way got a piece torn off a front winglet. Whilst expanding, fluid began to show at the break, and by the time the wing was fully extended, large drops hung all along the broken edge. This wing expanded as perfectly as the unbroken one; showing that there was enough fluid to do the work and some to spare.

I thought by maceration and manipulation to draw out the winglet to some extent; but was disappointed and not a little surprised to find that I could make little or no impression upon it in that direction. I afterwards thought that I discovered the reason of my failure.

I succeeded in cutting out a longitudinal section from between the heavy costal nervures of the winglet. Placing it on one of its cut edges under the microscope, I found that I had got a beautiful and intensely interesting object of contemplation. The gatherings of the membrane on the upper surface of the winglet, lay before me in a uniformly symmetrical row of elongated loops, with a row of tiny scales on the crest of each. The loops were nearly closed at their base, widest a little above their centre, making a narrow curve at their apex, open and quite empty. I looked for, and expected to find in the membrane of the underside, loops or gatherings, corresponding in some measure to those of the upper side, but could see none or anything resembling them. The membrane appeared only roughened and wrinkled. It was extremely thin and very frail, and the base of the loops seemed to be attached to its inner surface. The thought occurred to me that this would account for my inability to draw out the membrane of the winglet, and will in a measure explain the reason for the comparative slowness of their expansion as compared with butterflies. That is, supposing the wings of butterflies are constructed upon a different principle; but this is a point which will require much more careful investigation than I have given to it.

The extent to which the fluid of the insect gives color to the scales is a very interesting subject for consideration. The fluid differs in color in different species. The color of the fluid decides the color of the membrane in the expanded wing; but to what extent it affects the color of the scales is not so easily determined.

Prof. V. L. Kellogg, in his able and interesting paper, "The Taxonomic Value of the Scales of the Lepidoptera," which appeared in the Kansas University Quarterly, for July, 1894, on page 49 says: "The scales are attached to the wings by means of their short pedicels fitting into minute pouches or cups on the surface of the wing membrane. . . . The cups sink but slightly into the wing-membrane, the outer open end, being at the surface of the membrane, and the inner closed end or bottom of the pocket, being only slightly below the surface. . . . Thus the cups are more truly little pockets on the surface of the wing, than pits or cavities in it." On page 50 he says: "The pedicels of the scales are of slightly varying shapes and of different lengths, corresponding with the pockets into which they fit. Those which enter insertion-cups which are expanded at the base, or at some point between the base and the mouth, present at the tip or between the tip and the point of merging into the blade of the scale, respectively, a slight expansion, so that they are pretty firmly held in the cup by a sort of ball and socket attachment."

These quotations convey no intimation that there is any opening at the top of the scale, or that the tip passes through the inner surface of the membrane, whereby the fluid could enter the scales whilst flowing between the upper and under membranes of the wings. And yet I think we have positive proof that in some instances the fluid does enter the scales and influences to some extent their color.

When commencing his description of the structure of scales, the Professor, on page 51, says: "The scales are flattened sacs, composed of two membranes, enclosing sometimes only air, sometimes pigment granules attached to the inner face of one of the membranes, and sometimes (as observed in cabinet specimens) the dry remains of what may have been during life an internal pulp." Here in a foot note, Prof. Kellogg refers to Minot and Burgess, who, in their description of the anatomy of *Aletia*, declare that in all of the scales examined by them there was always an internal pulp which contained coloring matter. Then on page 69 Prof. Kellogg states that: "The colors of scales are produced by two causes: (1) The presence of pigment; (2) The overlapping, lamination and striation of the scales which produce those familiar but striking optical phenomena due to the interference of the waves of light. Combinations of these causes are usually present, so that the resulting color effects are practically incapable of analysis."

But there is a third cause of coloring. The long, slender scales on the winglets of a newly emerged *luna* are as pure a white as those upon the abdomen; when the wings are expanded these same scales are tinged with yellow. Whence did they obtain it? It is a well-known fact in the coloring of materials that a small quantity of green entering a pure white, a yellow is the natural result. Therefore the conclusion to me is irresistible, that a portion of the green fluid passing between the membranes of the expanding wings entered the scales—not enough to make them green, but sufficient to make them yellow. And there may be other lepidopterus insects which have the color of their scales modified in a similar way, but which will have to be detected by observing and comparing them in their unexpanded state with those on the expanded wing. The scales on an undeveloped wing are as much compressed, in proportion to their size, as the wing itself. As it requires the action of the fluid to expand the wing, the natural inference is, that similar causes are required to produce similar results in the scale; but whether there is an opening in the scale corresponding to that at the base of the wing, to admit the fluid, or whether it enters by cell absorption, has yet to be demonstrated. In the great majority of cases the scales have their colors decided in the chrysalis, by internal pigments probably. What change takes place, if any, during expansion, I have not been able to ascertain, except a perceptible brightening of the colors.

After my paper was written I received from Mr. Balkwill a chrysalid of *D. archippus*, which had matured up to the point of emerging, then died before accomplishing it. I removed a winglet and proceeded to investigate. I failed to extend this winglet as completely as I did that of Polyphemus. It was much more elastic, and I could draw it out about half its own length, but it would go back again, and it was easier drawn out laterally than longitudinally. I found it impossible to remove the scales by any means at my disposal, and was becoming hopeless of seeing the structure of the membrane. I removed the costal nervure, and when examining the cut edge with a lens I perceived in one place that the edges of the membranes had parted. By many efforts and steady directing I succeeded in getting the point of a pin between them, when I found that the winglet was like an empty sac. The two membranes were not in the least attached; even at the edges there was no pressure required to separate them, and the only thing that showed any symptom of holding them together was the fringes; so I separated the two membranes clean from base to apex without an effort, when the whole structure of the winglet was exposed to view. The nervures are in the upper membrane, with a groove in the lower, opposite, into which they fit. Both membranes are structurally alike, but the gatherings are perceptibly finer in the lower as compared with the upper. The surface, under the microscope, presented the appearance of a multitude of light grey transverse lines with dark spaces between. The gray lines are the under edge of the gatherings, whilst the dark spaces are the openings into the loops, on the crest of which the scales are situated. The transverse lines are not solid lines, but seemed to be made up of minute elongated dots. Near the base of the winglet some of the lines had the appearance of being composed of wide-spread W's. Elsewhere the lines of the W's were erect and closely packed. This gives quite a different view of the wing structure from that obtained in my former observations of the upper surface of the membrane. Here we see all the material that is required for producing a wing two inches in length by one inch at its widest part, compressed into a space less than three-fourths of an inch long and three-eighths wide. We also see that there is nothing to prevent its rapid, or even instantaneous expansion when the fluid from the living insect enters between the membranes in sufficient quantity and force; but that is required for the purpose, and nothing else seems capable of producing the wing extension; but why the fluid does not escape at the edges I do not know, and yet all the butterflies that I have observed burst their chrysalis always let fall some drops of fluid, and it may be that this is whence they come, and which would also account for the general external moistness of the imago at that time.

But to return to a consideration of the moths. I am now convinced that there must be an actual growth of the lower membrane during the progress of their wing expansion. There is nothing in its structure resembling the gatherings observed in the lower membrane of this butterfly. There is an appearance of looseness in its texture, but it has none of the elasticity of the other; it would tear rather then yield. Then again, when small moths are expanding their wings, the edges invariably curl under, as if the upper surface was extending more rapidly than the lower, which no doubt is the case, and is the cause of the curling, and as they press the two upper surfaces together it assists in extending the lower membrane and straightens out the curls. Here the question arises, are the wings of all moths constructed on the same principle? And are those of butterflies all constructed upon the other? The further one travels along such a road the greater appears the distance to the end.

BORDEAUX MIXTURE AS A DETERRENT AGAINST FLEA BEETLES.

BY L. R. JONES, BURLINGTON, VT.

Bordeaux mixture is a remarkable compound. After many comparative tests, experimenters have decided that no other mixture or solution yet discovered is equal to it as a general fungicide. Furthermore, those who have studied its action upon plants are agreed that it exerts upon them some beneficial influence entirely apart from its fungicidal effects.*

So far as I know, however, Bordeaux mixture has never before been experimentally shown to have value as a remedy against insects. Some experiments in this line made at the Vermont Experiment Station during 1893 and 1894 will therefore have so general an interest that I present the results before this Society.

Potato plants in Vermont suffer from the attacks of the cucumber flea beetle (*Crepidodera Cucumeris*, Harris). I cannot estimate the amount of the damage to the entire potato crop of the State from these insects, but I am convinced that it is most serious, especially during a dry summer, such as we have just experienced. In confirmation, I will pass around for your inspection, some leaves taken from our experimental potato plot at Burlington. You will perceive that many of them are completely riddled with the small holes eaten by these flea beetles. These leaves do not exaggerate the condition of the entire plants in many portions of our field. Leaves punctured and even skeletonized, as some of these are, suffer much from the loss of so considerable a portion of their leaf tissue. Moreover, leaves thus mutilated are most disastrously exposed to the effects of drouth during dry weather, and to the inroads of fungi and other parasites during wet weather. Indeed, these secondary injuries follow so closely after the attacks of the flea beetle, and the beetles themselves are so small and shy, that the great majority of potato growers attribute the entire trouble to these secondary agencies.

Entomologists have tried many remedies against these flea beetles. The one commonly recommended by them for use on potatoes is the standard insecticide, Paris green, mixed with land plaster and dusted upon the plants. As will be seen from our results below this poison has been of comparatively slight value with us. Certain fungicidal compounds, however, proved of decided worth in our experiments of 1893. These fungicides were originally applied to check the fungous diseases to which potatoes in Vermont are especially liable. Noticing that these sprayed rows were less badly eaten by the flea beetles, a careful count was made of the number of holes in fifty leaflets from each row of one plot under treatment. The results were as follows :†

In 50 leaflets sprayed with....	very weak Bordeaux mixture,	1,794	holes
" " " "	ammoniacal copper carbonate,	1,587	"
" " " "	modified eau celeste,	1,376	"
" " " "	weak Bordeaux mixture,	1,295	"
" " " "	strong Bordeaux mixture,	1,194	"
" " " "	strong Bordeaux mixture and soap,	945	"

These plants had been sprayed but once, August 1st. The examination was made August 12th. From our observations during the present summer (1894), we are convinced that most of the holes in the leaves sprayed with Bordeaux mixture had been made before the plants were sprayed at all, *i.e.*, before August 1st. The present season observations upon these insects were begun earlier. The beetles were first seen about June 1st. By June 12th some of our early potatoes were badly eaten. This attack lasted but a short time, however, and during the latter part of June and first two weeks of July but few beetles were seen. Suddenly, about July 20th, they again appeared in large numbers, and during the next ten days did great damage to unprotected potato plants. Previous to this time portions of our plants had been sprayed with various fungicides, and all the plants sprayed with the stronger copper compounds, especially with the Bordeaux mixture, have remained practically free from the flea beetle injuries up to date.

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*U. S. Dept. Agric., Div. Veg. Path., Bul. 7, p. 31.

It has been unusually dry with us, and in consequence our field is free from fungus oubles, yet the contrast between the sprayed and unsprayed rows is most striking. On e unsprayed rows every leaflet has from 50 to 500 flea beetle punctures, the plants are le and sickly, and are already beginning to shrivel from the drought. The rows rayed with Bordeaux mixture are practically free from the flea beetle mutilations, vigor-s and thrifty. I have brought for your examination two entire potato plants taken from joining rows, the one sprayed with Bordeaux mixture, the other not, which fairly repre-nts these differences. A few days ago two leaves were taken from each hill of these o rows and carefully examined. An average of twelve flea beetle punctures per leaflet s found on the row sprayed with Bordeaux mixture. On the adjoining row which had ceived no Bordeaux mixture, but had been freely dusted with Paris green (1 pound ris green in 50 pounds land plaster) there was an average of 262 holes per leaflet.

We therefore feel justified in advising the use of Bordeaux mixture on potatoes for new purpose, namely : As a deterrent against flea beetles. The use of Bordeaux mix-re as a fungicide has proved especially profitable with us during wet seasons. This wly discovered virtue will warrant its use during the dryest seasons also, since the flea etles are most troublesome then. Judging from our experience this season, in Vermont o applications of the mixture will suffice to hold these beetles in check, and upon late tatoes one application will probably prove sufficient. The first application should be ade upon early potatoes during the first week of June, and another about July 15th. is latter application is also well timed for the prevention of the fungus diseases of the tato. Upon later potatoes the earlier application just mentioned is not necessary. We ay, therefore, say that practical immunity from flea beetle injuries to potatoes may be cured at the cost of but a single application of Bordeaux mixture in addition to those ready recommended for the fungus diseases.

Regarding the value of other fungicides tested, modified Eau Celeste has proved arly as effective a deterrent against these beetles as has Bordeaux mixture. All of the her copper solutions tested have had similar deterrent effects roughly in proportion to e amounts of copper contained. The inference, therefore, is that the copper salt is the ement especially distasteful to the beetles. Soap, when mixed with these fungicides lds slightly to their value as deterrents, but not enough to justify its addition for neral use.

THE GYPSY MOTH (*Ocneria dispar*, L.).

By James Fletcher, Ottawa.

Of the many injurious insects introduced at various times from the old world, not e has, in as short a time, attracted so much attention, been so great a cause of anxiety, been so systematically fought as the Gypsy moth, since it appeared in vast numbers in e State of Massachusetts in 1889. As a practical object lesson of the value of scientifi-lly directed effort to overcome an insect enemy which had been allowed to increase noticed until it had assumed almost overwhelming proportions, the campaign which has en so successfully carried on for the last four years by the Gypsy Moth Department of e State Board of Agriculture of Massachusetts is of very great interest to all economic tomologists.

Having recently passed through part of the infested region, my attention was tracted to the trees bearing bands of burlap or marked with the various signs used by e inspectors to denote that they had examined the trees. Since my return to Canada, have been favoured with a full series of the excellent reports of the Commission, together ith much other information as to the methods of work, which have been kindly fur-ished by Prof. E. H. Forbush, the director of field work. On the whole, I think all ust acknowledge that, up to the present time, the efforts of the Commission have been ery successful ; but whether the enemy is entirely exterminated must depend upon hether the work is continued in the same careful manner for at least a few years longer.

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†For further details see Vt. Exp. Sta., Bul. 40, p. 25.

Mr. L. O. Howard, the United States Entomologist, one of the best qualified to express an opinion, says, in his recent address as President of the Association of Economic Entomologists, as follows: "The work upon the Gypsy moth which has been done by the State of Massachusetts since 1889, is one of the most remarkable pieces of work, judging by results, which has yet been done in Economic Entomology. The operations have been carried on by a Committee of the State Board of Agriculture, and the means have been furnished by large appropriations by the State Legislature. Three hundred and twenty-five thousand dollars have already been appropriated. A territory comprising something over 100 square miles was infested by the insects, which occurred in such extraordinary numbers as to destroy many trees, and almost to threaten the ultimate extinction of living vegetation, not only within the infested territory, but in all localities to which it might spread. . . . . The infested territory has been reduced by one-half, and within the districts in which the Gypsy moth at present exists, it is, practically speaking, a comparatively rare species. The future of the insect is, however, problematical. The continuance of sufficiently large appropriations from the State Legislature to enable the work to be carried on, on its present scale, is doubtful, and yet those in charge believe that still larger appropriations are necessary to bring about extermination. They are confident, however, that with sufficient means, the insect can be absolutely exterminated from the State of Massachusetts."

It will be instructive to consider how it was that this pest became so numerous before it was noticed, what measures were taken to control it, and lastly, what can be learned from the efforts of the Commission.

Prof. C. H. Fernald, the eminent Entomologist of the State, and Prof. Forbush have given, in the reports, most careful accounts of the introduction, habits and best methods of fighting this pest. There seems to be little doubt that the species was introduced into America in 1868, by a Mr. L. Trouvelot, then living near Glenwood, Medford, Mass., where he was carrying on experiments with various caterpillars as producers of silk. Having brought from Europe a cluster of the eggs of the Gypsy moth, he took them out of the box and laid them on the sill of an open window, whence they were blown away and lost. From this centre the moth scattered in every direction until, in 1891, it was found to have spread, during the twenty-three years, over thirty townships.

The chief causes of its increase are the prolificness of the females, the hardiness of the species, and the fact that it feeds upon almost every plant wild or cultivated; the caterpillars also seem much less susceptible to injury from the ordinary poisonous insecticides than most of our native caterpillars and being an introduced insect, of which all the members of the present devastating hordes were derived from one nest of healthy eggs, the species is not attended by the natural parasites which in Europe keep, as a rule, its numbers within reasonable bounds.

It seems strange that so voracious a creature as the Gypsy moth caterpillar could have increased so largely as is described in several letters from correspondents which are published in the 1894 report, without having attracted sufficient notice for some one to have sent specimens to the official Entomologist of the State sooner than 1889. Mrs. Belcher, of Medford, Mass., writes: "Mr. Trouvelot, who is said to have introduced the Gypsy moth into this country, was a next door neighbour of ours. The caterpillars troubled us for six or eight years before they attained to their greatest destructiveness. This was in 1889. They were all over the outside of the house, as well as the trees. All the foliage was eaten off our trees, the apples being attacked first, and the pears next. They ate nearly every green thing in my yard, killing my rose bushes and doing much damage to the vegetables. No one who did not see them at that time, can form any idea of what a pest they were. We killed many with boiling hot water, and would then dig a hole and bury them so as to prevent a stench. Mr. Belcher was poisoned by them. While he was killing them upon the trees, they would get upon his neck and poison it. It was impossible to stay long in the garden, for they would crawl all over one. We fought them for two or three years before the Commission took hold. When they hatched out in the spring, our fence would be one living mass, and while they were small it was almost impossible to keep them off one's person."

Mr. J. P. Dill, of Medford, also gives a graphic account descriptive of the great numbers and annoyance due to this scourge: "The caterpillars first appeared in May and were at their worst in July. They ate all the leaves off the trees until it seemed as though fire had run through them, trees finally becoming as leafless as in midwinter. After eating the apple tree leaves, they completely stripped a Bartlett pear tree. We got no fruit from either the pear tree or the apple trees that year. That summer we could have got the caterpillars out of the holes in the trees by pecks. After the caterpillars had eaten all the leaves off the trees, they went down into the grass where they swarmed. When the plague was at its worst, that summer, I do not exaggerate when I say that there was not a place on the outside of the house, where you could put your hand without touching caterpillars. At the time the caterpillars were the thickest on the trees, we could plainly hear the noise of their nibbling at night. It sounded like the pattering of very fine rain drops. If we walked under the trees, we got nothing less than a shower bath of caterpillars, which spun down from the trees by hundreds, even when they were of large size."

There are several letters in the same tenor, bearing evidence to the enormous numbers of this pest at the time when the assistance of the State Entomologist was sought in 1889. We find that immediately following this, vigorous steps were taken to make known the gravity of the occurrence, and the Legislature was induced to make appropriations and appoint the Commission, which, by its energetic and successful efforts, has attracted the attention and admiration of the whole world.

Undoubtedly, one of the reasons that this insect made such headway without being noticed generally, was the culpable and unpardonable ignorance which prevails everywhere and in all countries, even among sensible people, concerning the habits of the injurious insects which yearly destroy such vast quantities of produce of all kinds. This ignorance on the part of the public is unpardonable, because it is in a large measure unnecessary; not only have efficient remedies been found out by officers paid by themselves through the State treasury, but the results of the work of these officials are in most cases at the disposal of anyone who will ask for them. Another reason that the pest did not sooner attract attention, was probably that the caterpillars feed normally at night, and during the day hide in cracks and crevices of the bark, or rest on the trunks of trees, where by reason of their colouring they are not easily detected. It is only when their numbers become excessive and the food supply is diminished, that they feed at all times of the day and night, and wander from place to place. A feature of the work of the Commission has been the making known, as widely as possible, the appearance of this insect in all its stages. Not only were beautifully coloured plates published in all the reports, but show cases were made up and distributed to schools and public institutions, illustrating by actual specimens the appearance of the eggs, caterpillars, chrysalis, and perfect moths.

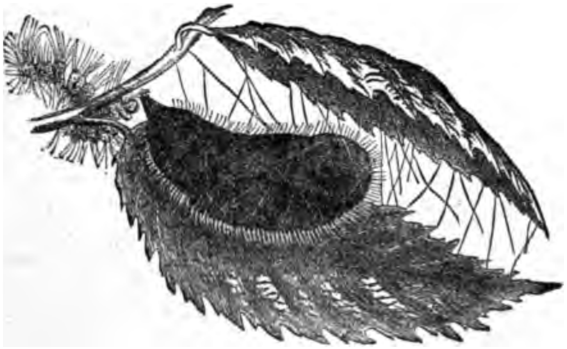
Fig. 44.—Gypsy moth, chrysalis.

The eggs are laid from July to September in oval or rounded clusters, containing from four to five hundred eggs, covered with the yellowish hair from the body of the female. These clusters of eggs are placed indiscriminately on any object near to where the female emerges from the chrysalis (Fig. 44), on trees, fences, stone walls, etc. They are mostly laid about the middle of July, and do not hatch until the following spring. Both the egg-laying and the hatching of the young caterpillars are very irregular, so that the insect may be found active throughout the season. The caterpillars (Fig. 45), although extremely voracious, take a long time to complete their growth. When full-grown, they are nearly two inches in length, and although gaudily marked when examined closely, they are nevertheless inconspicuous when at rest on trees. "The general colour of the body is creamy white, thickly sprinkled with black. The ground colour shows in the dorsal and lateral lines which are somewhat broken. The tubercles on each side of the dorsal line from the second to the sixth inclusive are blue and give rise to short black spines. On each side of the remaining segments, except the last, the tubercles are dark crimson. On the top of the tenth and eleventh segments, on the dorsal line is a small cylindrical fleshy tubercle without hair or spines, the top of which is slightly inverted. It is uncertain what is the function of these organs, but it is quite possible they are scent organs."

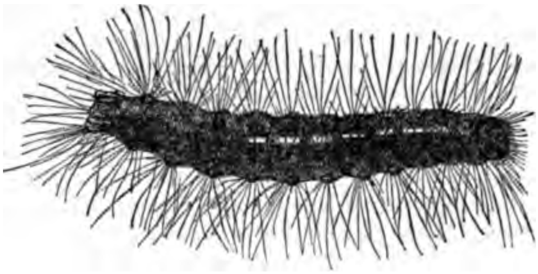
Fig. 45.—Gypsy moth, caterpillar.

"On the posterior edge of the last segment are four bluish-white tubercles giving rise to black spine-like hairs. The spiracles are oval, pale yellow, and encircled with black. The legs are dark crimson and the pro-legs flesh-coloured and streaked with reddish-brown."—(*Fernald.*)

There are other but less conspicuous markings, which it is not necessary to mention here. When full-grown, the caterpillars spin a small quantity of silk and change to the chrysalis condition. This usually occurs in July or August, and in Massachusetts the insect remains in this state from eight to twelve days.

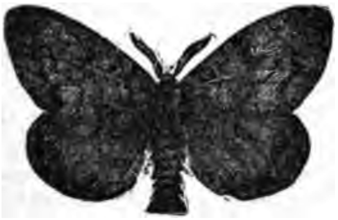
Fig. 46.—Gypsy moth, male.

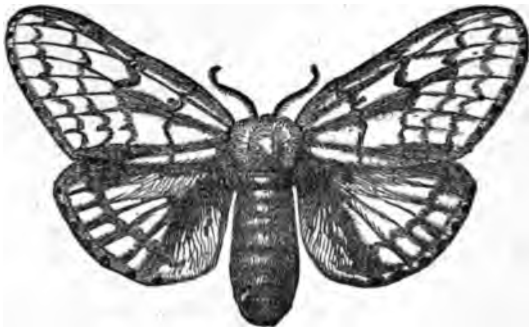
Fig. 47.—Gypsy moth, female.

The male (Fig. 46) and female (Fig. 47) moths are very dissimilar in appearance. The former measure from one and a half to two inches across the expanded wings. The ground colour of all the wings is brownish-yellow, varying in intensity in different examples. The head, thorax and antennæ are grayish-brown. The wings are crossed by about four waved black lines which are darkest on the costal edge of the wings. The terminal space is also darker than the rest of the wing, and the fringe is cut with dark brown between the veins. The males fly easily, in which they differ from the females, which can only fly down from an elevation.

The females are larger, varying from one and a half to two and a half inches between the tips of the wings; the entire body is white, except the abdomen beneath and the tip above, which are yellow. The markings on the fore wings are dark brown, or nearly black, but in some specimens are almost obliterated. The figures shown herewith have been kindly lent by Prof. Forbush, and give the general appearance of the markings of the two sexes, the chrysalis and the caterpillar.

The methods, which have been adopted in the prosecution of such extensive operations as have been necessary, have been changed from time to time according to circumstances and experience, and many valuable data have been recorded which will be of great assistance for reference in future work. For carrying on this warfare, it was necessary to train all the inspectors and the many men required to cover the ground, and to attend to the many details connected with the destruction of the insect in its various stages, and the prevention of its spread into other districts. This involved an immense amount of careful work, which naturally took much time and money. A small hand-book, entitled "Laws, Rules and Regulations relating to the extermination of the Gypsy Moth," was printed for the use of the employees, giving a copy of the Act of 1891, authorizing the work, "Rules and Regulations for the Public," most complete "Rules and Regulations for the Agents" employed, and finally a very complete but concise account of the life history and habits of the Gypsy moth.

The methods employed were briefly as follows: The destruction of the egg was effected by saturating the clusters with creosote oil, dilute nitric and carbolic acids. For the caterpillars, trees were banded with burlap, which provided a hiding place in which they were afterwards destroyed; or a material called "raupenleim" or "insect lime," was placed upon the bands to prevent the caterpillars from climbing trees. Underbrush was cleared out wherever possible, and useless and hollow trees which would form hiding places, were cut down and burnt. Traps were also devised in which females were enclosed for the attraction of the males, which were successful. Wherever possible, shade trees, orchards and woodlands were sprayed with poisonous mixtures. As it was known that the moths were disseminated mainly by vehicles driving beneath trees in infested centres, efforts were made to inspect all vehicles going out of such districts and to clear thoroughly all trees along the roads. Great care seems to have been taken to obtain an accurate knowledge of the extent of the infested territory. Prof. Forbush, in his 1894 report, says: "The means, which though expensive, have given the best results and have finally exterminated the moth from localities and towns, consist of a thorough long-continued and repeated search by competent men, not only of all known infested localities, but of entire towns. The moth is now so rare in most of the infested towns that it is only by such search that it can be found, and this search must be relied upon to assure extermination. When a colony is found, all forms of the moth must be destroyed; loose bark must be scraped from the trees, the undergrowth cut and burnt, all cavities which may serve for hiding places filled, and the locality carefully watched for at least two years."

Among the good results of this investigation is the discovery of the value of Arsenate of Lead as an insecticide. The experiments with insecticides made under Prof. Fernald's direction, prove that the arsenites as commonly used for spraying foliage are comparatively ineffectual against the Gypsy moth. It was found that the caterpillars will feed for days without apparent injury, upon trees which have been sprayed with Paris green or London purple, in a mixture so strong as to somewhat burn the leaves. In fact, the committee, in the spraying they are carrying on at present, have found it necessary to use arsenate of lead in as strong proportion as 10 pounds to 150 gallons of water. The great value of arsenate of lead is that it can be used freely upon foliage without danger of injury to the plant, as is the case with the generally used arsenites, Paris green and London purple. The greatest success in clearing the infested districts seems to have been secured by destroying the eggs late in the summer and in early fall, as soon as possible after they are deposited. If they are not disposed of at this time, some of the egg-clusters may be broken, and the eggs scattered by man, animals, or the elements. The treatment with acids is preferable to collecting, as there is less danger of breaking up the clusters and dropping the eggs. For the destruction of the caterpillars, Prof. Forbush reports that "the method of banding the trees with burlap is the most effective one yet devised to dispose of this form of the moth. The burlap offers them a convenient shelter, and if it is put on all infested trees, and frequently examined, many caterpillars will be caught that would otherwise escape notice. One hundred and fifty thousand yards of this material were purchased. It was cut into strips and applied to the trees in infested localities. It is necessary to examine the burlap bands once each day, or at least once in two days, to be sure of securing all the caterpillars which gather beneath them."

In view of the great difficulties which the commission had to face in solving the problem of the extermination of the Gypsy moth, the immensity of the work, the impossibility of forming a true estimate of the extent of the infested country or of the money required and, as it turned out, of the habits of the insects and the best remedies, too great credit cannot, I think, be given to those who have so wisely and ably directed the efforts to stamp out this dire enemy.

It will, indeed, be short-sighted policy, if the Legislature of Massachusetts does not now provide the funds necessary to finish up this good work. For nothing is more certain than that, if the amount estimated by the director with all the experience of the past three years, as absolutely necessary, be not forthcoming, not only will all the good work already accomplished be nullified, but at some time in the future it, and much more, will have to be done over again at a far greater expense. In concluding his last report, Prof. Forbush says: "The statute under which the committee is appointed, calls for extermination. The cost of extermination is great. It certainly costs more to search for the last egg-cluster, caterpillar or moth, than it would to destroy the majority of them and thus prevent both dissemination and damage for the time being. But if larger sums of money than those already appropriated can be secured and the extermination of the moth can be accomplished, an expense will be stopped, which must otherwise be continually increasing and which must be borne annually for an indefinite period, either by the State or by all residents of the country over which the moth would extend its constantly widening range. Encouraging progress towards extermination has already been made with manifestly insufficient funds and in the face of many obstacles. The numbers of the moth have been so reduced that no material damage has been done by it during the past two years. It has been exterminated first from single trees, then from orchards, woodlands and entire towns. More than 800 infested localities have been entirely freed of its presence. This work was begun on the borders of the infested region, and has progressed toward the centre until the moth appears now to have been exterminated from more than one-third of the region infested in 1891."

This was written in February, 1894. In Prof. Fernald's report, published in the same volume, are statements from six of our most prominent official entomologists, all of whom testify to the admirable way in which the work has been carried out. Prof. Packard says: "It seems to me that the work is practical and thorough throughout." Prof. Weed, of New Hampshire, says: "I have never seen a series of similar experiments carried on in so large a scale or in so thoroughly scientific a manner." Dr. Fernald, of Pennsylvania, says: "A careful consideration of the methods used and of the results already obtained, has convinced me that the extermination of the Gypsy Moth is not only possible but certain, if the work be prosecuted for a sufficient length of time." Prof. John B. Smith says: "The force has accomplished wonders, and I feel that there is very good reason for the belief that the Gypsy moth can be exterminated, provided the means are furnished." Dr. Lintner, of New York, says: "How a work of such magnitude, extending over so large a territory, could have been accomplished was a wonder and an enigma to me, until I became acquainted with the means by which it had been brought about."

THE SAN JOSÉ SCALE. (*Aspidiotus perniciosus*, Comstock).

BY JAMES FLETCHER, OTTAWA.

The unexpected discovery, in the Eastern United States and British Columbia, of this scourge of the Pacific Coast orchards, makes it all-important to draw the attention of Ontario fruit-growers to the subject, so that they may become familiar with its appearance and be prepared to adopt active measures to eradicate it, should it, as it is more than probable, appear in our province.

In August, 1893, the first eastern specimens of the San José scale were brought to the notice of the United States Entomologist, and he at once took active measures to find out all that was to be learned concerning its distribution and injuries, with the object of stamping out such a formidable enemy. In April, 1894, Mr. Howard issued a circular under the caption, "An Important Enemy to Fruit Trees," in which he gave a short history of the insect and the most approved remedies. He has been kind enough to lend Fig. 48 from that bulletin, which will be of great service in giving an idea of the appearance of the insect.

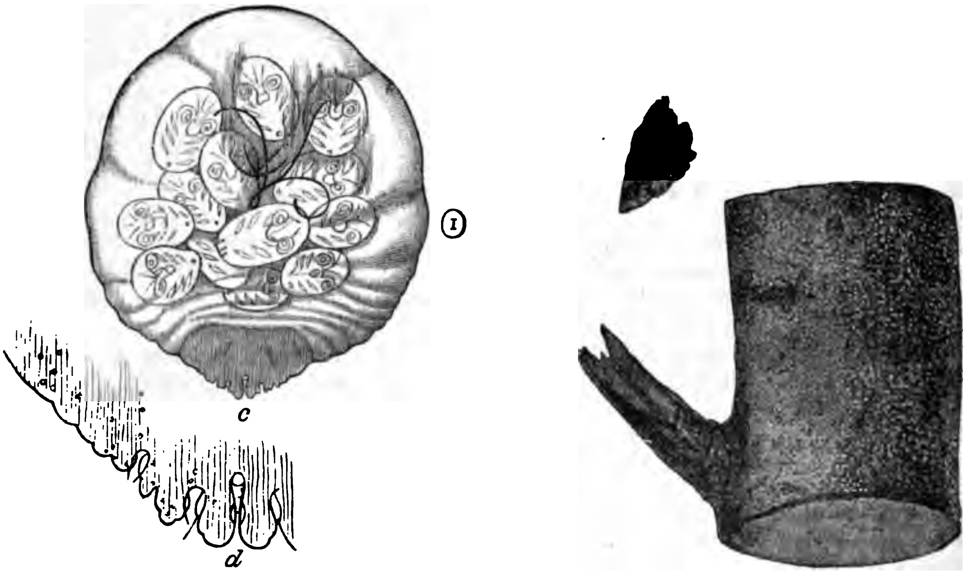

Fig. 48.—San Jose Scale, female enlarged and part of infested branch (life size).

The San José Scale was first brought to California it is thought, from Chile about 1870, and it was first noticed as injuriously abundant at San Jose in 1873, and called the San Jose Scale. "It does not seem to have been named scientifically until 1880, when Prof. Comstock described it in his annual report to the United States Department of Agriculture—he designated it *perniciosus*, because he considered it the most pernicious scale insect known in the country. It swarmed in countless numbers upon the trees in certain orchards, and infested all the deciduous fruits grown in California, except the apricot and Black Tartarian cherry. In the course of twelve years, the insect spread through all the fruit-growing regions of California, through Oregon, and into the State of Washington. It is known as the worst insect pest of deciduous fruit trees on the Pacific coast, and has caused great pecuniary loss. Many crops of fruit have been ruined, and thousands of trees have been killed." (L. O. Howard, Circular 3.)

In 1892 the insect was found in New Mexico on apple, pear, plum, peach, quince and rose. It had been brought into New Mexico upon young trees from California. Nearly all the other instances of infestation east of the Rocky Mountains can be traced to two nurseries in New Jersey, where the pest had been introduced in 1886 or 1887 on trees of the Japanese plum "Kelsey," which had been procured from the San Jose district in California. Idaho pear trees had also been frequently imported from California which were most probably infested. In 1891 and 1892 several blocks of young apple trees were badly infested. It is on pear trees chiefly that this pernicious scale has been distributed through the state of New Jersey. Prof. J. B. Smith says (Insect Life, VII., p. 166): "The Idaho pear has been the most dangerous because it came infested whenever imported direct, and after it came in close order, Madame von Siebold, Garber, Lawson, Seckel, Lawrence and Bartlett. Other varieties are also infested, but less frequently, and the scales do not do so well. Kieffers alone are absolutely exempt, and closely following comes the Leconte, which is rarely infested in the nursery, and never in the orchard, in my experience. One tree grafted with Lawson and Kieffer had the Lawson branch and fruit covered with scales, while the Kieffer branch was entirely free. Currants, black and red, became rapidly infested, and the scales were certainly distributed on these plants."

Mr. Howard says that this insect spreads rapidly for a scale insect, and is the most dangerous scale known. It is, too, inconspicuous and would be overlooked by many. Specimens of infested apple boughs received from British Columbia were entirely incrusted with the scales so as to give them the appearance of having been dusted with ashes. Mr. Howard gives the following description of the scale in his circular above referred to: "The San Jose Scale belongs to the same group of scale insects—the Diaspinæ, or armoured scales—to which the Oyster-shell Bark-louse of the apple belongs. It differs from this species, and in fact from all other eastern species found upon deciduous fruit trees, in that the scale is perfectly round, or at most very slightly elongated or irregular. It is flat, pressed close to the bark, resembles the bark of the twigs in colour, and when fully grown is about one-eighth of an inch in diameter. At or near the middle of each scale is a small, round, slightly-elongated, black point; or this point may sometimes appear yellowish. When occurring upon the bark of the twigs or leaves, and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened scurfy deposit.

The natural rich reddish colour of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they have then every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft yellow insects beneath the scales, and this will at once indicate to one who is not familiar with their appearance the existence of healthy living scales on the trees. During winter the insect is to be found in the half-grown or nearly full-grown condition. The young begin to hatch and to crawl from under the female scales shortly after the trees leaf out, and from this time through the summer there is a constant succession of generations. The insect affects not only the young twigs and limbs, and with young trees, the entire plant, but is also found upon the leaves and upon the fruit. When abundant, the fruit is destroyed. One of the most characteristic points in the appearance of the insect upon fruit, is the purple discoloration around the edge of each scale.

The above description will enable fruit-growers to recognize this enemy, should they be unfortunate enough to get their orchards infested with it.

REMEDIES.

With regard to remedies, we have the advantage of all the experience of Californian experimenters and the careful work of the Division of Entomology at Washington, as well as of Prof. J. B. Smith of New Jersey during the past year. There are three methods which have proved effective in fighting the San Jose Scale. In cases of severe attack it is recommended to cut down the infested trees and burn them. The other methods are, spraying with insecticidal washes, or fumigating the trees with poisonous gases. The insecticidal washes may be divided into summer washes, which can be applied while the trees are in leaf, and winter washes of a stronger nature, which would injure the foliage but will do no harm to the trees during the winter, when they are in a dormant condition, and yet will have the effect of destroying the scale insect. Of the *summer washes*, the ordinary kerosene emulsion (Riley-Hubbard formula) and a resin wash [resin 20 lbs., caustic soda (70 per cent. strength) 5 lbs., fish oil 3 pints, water 100 gallons] were recommended by Mr. Howard, and used with success during the past summer. On peach trees, owing to the susceptibility of the foliage to injury, the stock kerosene emulsion was diluted with fifteen times its volume of water, instead of nine times, the usual strength advised for most other plants. It was found advisable to repeat the sprayings at intervals of about a week. The young scale insects were noticed on May 19th at Riverside, Md., and the females, viviparous in habit, gave birth to young for a full month. This was upon peach trees, and it was found that the resin wash killed the scales more quickly than the very diluted kerosene emulsion, and, as Mr. Howard points out, this rapidity of the work is important, since where a full-grown female is sprayed with kerosene emulsion, she may live for three or four days, during which time she brings forth young; whereas if sprayed with the resin wash, fewer young scales are produced. The resin wash, however, is readily carried off by the rains, while the kerosene is more resistant.

In Professor J. B. Smith's investigations in Pennsylvania, it is recorded (Insect Life, VII, p. 159) that, "he has visited the locality at Atglen, Pa., and found that in an orchard of over 7,000 trees, all of certain varieties, and a few of others, were infested by the scale. As a result of his recommendations, kerosene emulsion has been applied three times to most of the trees at intervals of ten days, up to the first week in June. The treatment has been absolutely successful."

For *winter washes* the kerosene emulsion and resin washes may be made stronger. The stock kerosene emulsion has been used diluted with only four and a half parts of water, and for the resin wash the same ingredients were used in the following proportions: Resin, 30 lbs.; caustic soda, 9 lbs.; fish oil, 4½ pints; water, 100 gallons.

"The most favored winter remedy in California, however, is the lime, salt, and sulphur mixture. This consists of unslaked lime, 10 lbs.; sulphur, 5 lbs.; stock salt, 5 lbs.; water to make 15 gallons. This wash will do great damage to the trees if applied during the growing season, *and should be used only in winter*. All the sulphur and half the lime are placed in a kettle and 8½ gallons of water added, after which the contents of the kettle are boiled briskly for about an hour. The solution which at first is yellow from the sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the salt is added to the remaining 5 pounds of lime and the latter slaked, after which the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make 15 gallons. This should be strained before application, as it does not form a perfect liquid solution on account of the considerable quantity of undissolved lime, which will soon sink to the bottom unless the solution is constantly stirred while being sprayed."

The third method of fighting scale insects is known as the Gas Treatment. This has been extensively used in California but is an expensive operation, and the materials necessary are very poisonous and dangerous to have about. It consists, briefly, of covering the tree to be treated with an air-tight tent and then filling the tent with the poisonous fumes of hydrocyanic acid gas, which is generated by placing 1 oz. of cyanide of potassium, 1 fluid oz. of sulphuric acid, and 3 fluid oz. of water in an earthenware vessel beneath the tent. The gas is very light and rises to the top of the tent, and if this be kept on the tree for half an hour, every scale will be destroyed. The quantity of ingredients given above is sufficient for a tent enclosing 150 cubic feet.

What is wanted, however, is to know *the best remedy*, and it is satisfactory to learn that on the whole the standard remedy for scale insects, kerosene emulsion, is the best. In summing up his experience of the year, Mr. Howard says as follows: "Remedial work against this insect is onerous, but our experience has shown that three sprayings at intervals of ten days during the latter part of May and June, will practically destroy the insect, whether the spraying be conducted with very considerably diluted kerosene emulsion or with a resin wash, while during the winter a single application of either of the three winter washes will greatly reduce the numbers of the insect. Among the winter washes our experience leads us to give the preference to strong kerosene emulsion; next, to the winter resin wash; and finally, to the lime, salt, and sulphur mixture.

The kerosene emulsion is now well-known to most Canadian fruit-growers; but it may be well to give it here.

Kerosene (coal oil)	2 gallons.
Common soap or whale oil soap	½ pound.
Water	1 gallon.

Cut up the soap and boil in the water till all is dissolved, then add it boiling hot to the coal oil; churn the whole briskly for five minutes with a syringe or force pump. When the emulsion is perfect, it will adhere without oiliness to the surface of glass, and when cooling forms a jelly-like mass, which can be kept indefinitely if stored in a cool place and covered from dust.

When required for use, for a summer wash dilute one part of the stock made as above with nine or fifteen parts of water. To make the stock dissolve easily, take first three parts of hot water to one of the emulsion, and then, when all is thoroughly mixed, add sufficient cold water to make the nine or fifteen parts required; for a winter wash mix with four and a half or nine parts of water.

INJURIOUS FRUIT INSECTS OF THE YEAR 1894.

By J. Fletcher, Ottawa.

The season of 1894 has been a busy one for the practical entomologist. Not only have the usual complaints come in of injury by the canker worm, codling moth, curculio, cut worm, etc., but beside these there have been special developments of some well-known species, and some new invaders have appeared within our borders. Of these last the most notable are the Pear-tree Psylla, which occurred in large numbers in an orchard at Freeman, Ont., and the San Jose scale, of which undoubted specimens were sent in from British Columbia. The attention paid generally to the remedies advised by entomologists is decidedly much greater to-day than it has ever been before. This is largely due to the satisfactory results which have been obtained by new methods in treating insect enemies, and also by the even more remarkable successes of botanists in controlling fungous diseases. The combined application of fungicides and insecticides is still being carefully studied and the practice of adding Paris green or some other arsenite to the Bordeaux mixture for the treatment of fruit trees, has now been widely adopted by the best fruit-growers. The late action of the British Columbian Government in condemning and destroying shipments of fruits which on arrival were found to be infested by injurious insects illustrates the vigorous policy which has been adopted by the Provincial Board of Agriculture to protect their important fruit industry. This action will also doubtless have the effect of turning the attention of careless and improvident fruit-growers to the subject, and of inducing them to adopt the simple and cheap remedies which entomologists have been advocating for the last ten years and which must certainly result not only in increased wealth to themselves and the province, but gradually in reducing very materially the amount of injurious insect-presence in the Dominion.

The insect which was the cause of the condemnation of the shipments of apples in British Columbia, was the codling moth (Fig. 49 shews the work of the grub in the fruit) which, remarkable as it may seem, has not as yet been authentically recorded as breeding in British Columbia, although it is perhaps to-day the worst enemy of the apple in Eastern Ontario. If it be true that the codling moth is not already established in British Columbia, the wisdom of the Government of that Province in using every reasonable means of keeping it out, must commend itself to everybody.

Two of the worst enemies of the fruit grower are the codling moth (*Carpocapsa pomonella*) and the plum curculio (*Conotrachelus nenuphar*). [Fig. 50 represents all stages of the insect.] After a great many experiments under varying circumstances, spraying the trees with Paris green (one pound of Paris green, one pound of fresh lime and 200 gallons of water) still remains the best remedy; I believe that whether these insects are known to be present or not, it will well repay fruit growers to spray their orchards at least once every spring as a regular operation. Numerous instances have been reported to me of astonishingly successful results from following this course, and hardly any failures; so I can repeat what I said last year, that "where this work is done carefully and intelligently, it is practically all-sufficient." The occasional cases of failure which are sometimes heard of, and these are very rare, are almost invariably due to careless work. In the January number of the *Canadian Horticulturist*, I published an open letter requesting fruit-growers who had failed to obtain paying results from spraying plum or apple trees, to write to me on the subject After nearly a whole year, I have not received a single unsatisfactory reply; furthermore, at the last annual meeting of the Fruit Growers' Association of Ontario, held at Peterboro', the question of spraying apple trees for the codling moth and plum trees for the curculio, came up for discussion. During this meeting which I had the pleasure of attending, I requested those present who had sprayed with Paris green against those insects, to give the results of their experience. Some convincing instances were given by leading members of the Association, which proved the efficacy of the treatment recommended.

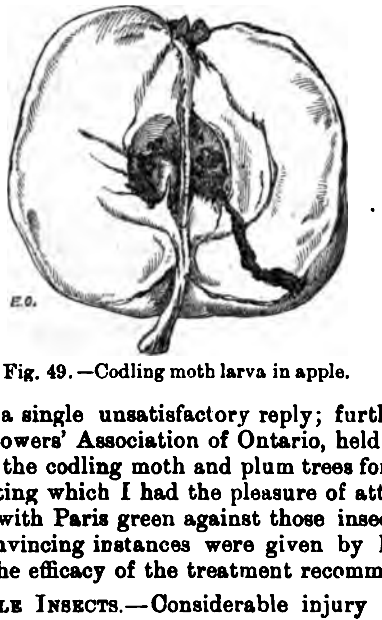

Fig. 49.—Codling moth larva in apple.

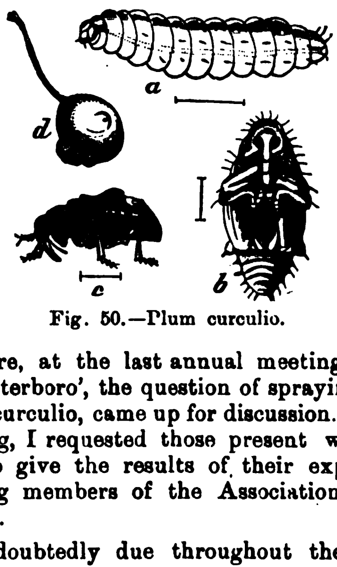

Fig. 50.—Plum curculio.

Scale Insects.—Considerable injury is undoubtedly due throughout the whole Dominion to the operations of the inconspicuous but very pernicious scale insects; the most redoubtable of these is the Oyster-shell bark-louse (*Mytilaspis pomorum*, Bouche), and it competes every year with the codling moth for the honour of being the worst enemy of the apple tree. The life history, in this species as well as in most others, gives us a suggestion as to the best time to apply a remedy. The scales (Fig. 51) may be found upon the twigs and branches of apple trees, black currant bushes, mountain ash, ash and many other trees during the winter. From these during June emerge minute, white mite-like insects with six legs (Fig. 52), which for a few days crawl about the trees seeking for a suitable spot for them to attach themselves. This is generally on the young wood of the previous year. It is only during these few days that they are able to move, for having chosen a spot they pierce the bark with their needle-like beaks and remain fixed for the rest of their lives. Each gradually secretes a waxy mantle (Fig. 52, 3), and by August has transformed into a scale (Fig. 52, 7), in the case of the females, covering a cluster of eggs. The scales of the males are much smaller than those of the females and of a different shape. The eggs do not hatch until the following June. While the young are in the active state they are very much more susceptible to injury than after the scales are formed. The time of hatching varies somewhat in different localities, but by examining the trees this date can be easily ascertained, and if the trees are then sprayed with a diluted mixture of kerosene emulsion the insects will be destroyed. A good time also to spray the trees, is early in spring before the buds burst. It is a matter of surprise to some how these insects which pass their lives for the most part attached firmly to the bark can spread so rapidly through an orchard, as they frequently do. This has been explained by the suggestion that at the time the young lice first hatch, they are very active and crawl with great agility. At this time of the year, the trees are much frequented by birds and other insects, upon which the lice crawl and are then carried from tree to tree by these larger winged creatures.

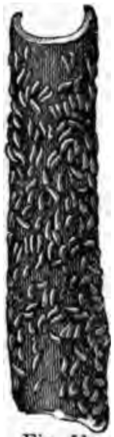

Fig. 51.

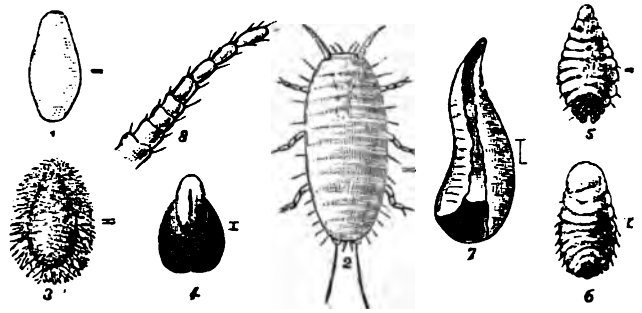

Fig. 52.—Oyster-shell Bark-louse.

Belonging to this same class of scale insects, is the pernicious San Jose scale which on account of its importance, is treated of in a separate article.

Another enemy of fruit trees which has this year for the first time appeared in the Dominion, is the Pear-tree Flea-louse, (*Psylla pyricola*, Forster), specimens of which were sent in from Freeman, Ont., by Mr. J. S. Freeman, who writes: "I have a block of 300 dwarf Duchess pear trees mixed with apple trees, which are so badly affected with the insects which I am sending you, that from the appearance of the trees at present, the whole crop will be destroyed. I do not think that the pear trees have been troubled before this season. They are more or less over the pear trees of different kinds in my nine-acre orchard. From inquiries of other fruit-growers in this section, I think it likely that this pest occurs in other orchards too." At the time of receiving the specimens the insect was in the pupal form and just about to assume the perfect state. Mr. Freeman was written to as to the nature of the insect, and he was recommended to spray his trees with kerosene emulsion at the time, and to repeat the application early next spring when the buds burst, that being the season when the young hatch from eggs laid by females which are now hibernating on the trees. This has been found to be the most successful treatment.

The Pear-tree Flea-louse belongs to the same class of insects as the aphids or plant lice, with which they form the second section of the *Homoptera*, known as *Dimera*, or those with two-jointed feet. In this section we find small insects with antennæ longer than the head and in the winged individuals four wings, ordinarily all of the same membraneous texture. The *Psyllidæ* or flea-lice are small insects found on leaves and in some species, as the Hackberry flea-louse, give rise to galls. They have long slender antennæ terminated by two bristles. The beak is short and tri-articulate, and the eyes are lateral and prominent as in the *Cicadae*. In fact, these little flea-lice, although seldom much more than one line in length, very much resemble *Cicadae* in miniature. On the front of the face are three ocelli placed in a triangle, the posterior ones quite close to the eyes. Unlike the *Aphides* or plant lice, the flea-lice have the power of leaping, from which they take their English name.

The Pear-tree Flea-louse is an introduced insect which was first recorded as injurious in America in 1833, according to Dr. Harris. It seems to be widely distributed in the Eastern United States and occasionally has developed into a serious pest. It has been treated of at various times by Dr. Lintner, Dr. J. B. Smith and the Washington Entomologists. The most important articles are those by Prof. Lintner in his Ninth Report and Prof. Slingerland in Bulletin 44, Cornell Univ. Agr. Exp. St., October, 1892, where a complete account is given of its life history and habits.

The presence of this insect is easily detected by the copious secretion of honey dew with which the leaves of the infested trees are covered and which soon becomes covered with the dirty looking black fungus (*Fumago salicina*),and also, after a time, by the falling of the foliage. The insect itself is about one-tenth of an inch in length, of reddish brown colour, with broad black bands across the abdomen, with transparent wings, the fore wings bearing one large vein which is divided into three forks, which again are bifurcated at the extremities. The immature insect, when first hatched, is a curious flattened oval creature, semi-translucent, yellow and very inconspicuous, only one-eightieth of an inch in length. It grows rapidly and in about a month passes through the five nymph stages, the last two of which are called the pupal stages and have black wing pads and blotches of the same colour on the body. Dr. Lintner records at least four broods during the season. An encouraging feature noticeable in all the accounts of this insect is the irregularity of its appearance, its occurrence in large numbers one year very seldom indicating that it will be as abundant the next.

Another very troublesome enemy of the fruit-grower is the Cigar Case-bearer of the apple (*Coleophora Fletcherella*, Fernald), which has been sent in from several places in Ontario and the Maritime Provinces. The first specimens were from Mr. Edwin Worden, of Oshawa, Ont., who in March sent twigs of apple trees thickly infested with the hibernating larvæ of the case-bearer, and the cocoons of the interesting little moth *Micropteryx pomivorella*, Pack. Specimens of the former came also from the Grimsby district, where it was stated that Greenings suffered most. Later in the year I had a visit from Mr. Harold Jones, of Maitland, Ont., who has suffered much from this small but very troublesome insect. He estimates his loss at fully the average fruit of one hundred trees. This has proved an extremely difficult insect to control. The life history is as follows:

The eggs are laid by the tiny moths during July. The young larvæ hatch in about a fortnight, and burrowing into the leaves, feed upon the parenchyma for a short time. They then cut out from both surfaces of the leaf oval pieces of the epidermis, with which they form their curious cases. Mr. Jones observed the young larvæ beneath the leaves about the 10th of August, and by the 1st of September they were clustered on the twigs. Here they remain all the winter with their curved cases, fastened securely to the twigs with white silk. As soon as the buds open in spring, they crawl out on the twigs and attack the unfolding leaves and flowers. As the leaves get larger, they confine themselves to the leaves, feeding chiefly on the undersides, where they bore a circular hole through the epidermis and extending their bodies into the cavity between the upper and lower surfaces, make large blotch-mines. They also do much harm by attacking the stems of the flowers and forming fruit. About the third week in June the larvæ crawl to the upper surface of the leaves, and, having fastened their cases down, change to pupæ inside them; the very small dark brown moths, a quarter of an inch in length, appearing from the second week to the end of July.

The remedy, which has been tried for this insect with the greatest success, is spraying with kerosene emulsion early in spring. Dr. Young, of Adolphustown, who suffered much from this insect, writes me on July 3rd last: "On the large block of Duchess apple trees, where we sprayed with Paris green in 1891 and '92, when the case-bearers were so numerous, there is now only an odd worm to be seen; but in other parts of the orchard, where they had scarcely reached at first, they were numerous this spring. The kerosene emulsion, either warm or cold, used in the winter had no effect; but when used cold in the spring, after the worms began to move about, was very effectual. It more completely cleaned the trees of the case-bearers than did the Paris green. Still the Paris green did well, and took most of them off. We sprayed with both the same day." It is rather remarkable that this insect, in Nova Scotia and Prince Edward Island, attacks the plum and pear as well as the apple; but at Oshawa, Mr. Worden reports that, although he has plum and pear trees side by side with his apple trees, the latter alone are attacked.

An insect which has caused considerable damage to fruit growers is the Oblique-banded Leaf-roller (*Cacœcia rosaceana*, Harris). Fig. 53 represents the moth with open wings; fig. 54, with wings closed; fig. 55, caterpillar and chrysalis. It is frequently a troublesome pest on apple trees and currant bushes. This year it was sent to me as an enemy of the birch, apple, pear, gooseberry, black currant, garden geranium, and a rare interesting attack was noted in which it was destroying the seeds only of the silver maple. In fact this insect seems to be a pest upon a large number of shrubs and trees, upon any one of which it may develop injuriously under special circumstances. The general practice of spraying fruit trees with the arsenites, for the codling moth and the leaf-eating insects, will certainly reduce largely the occurrence of the Oblique-banded Leaf-roller.

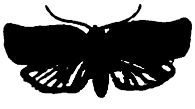

Fig. 53.

Fig. 54.

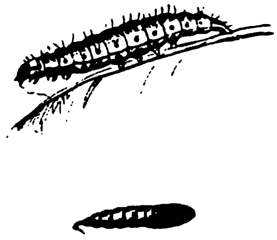

Fig. 55.

Oblique-banded Leaf-roller.

The peach orchards in the Niagara district have, during the past two years, suffered seriously from the Peach Bark-beetle (*Phlœotribus liminaris*, Harris). Careful experiments have been begun in the extensive orchards of Mr. C. E. Fisher and Captain J. Sheppard, at Queenston; and it is hoped that before long a practical remedy will be discovered. It has usually been stated that this insect attacks only injured or dying trees; this, however, is certainly not the case, for it was found in perfectly healthy and thrifty young two-year-old peach trees; although very much more abundantly in older trees with rough bark. Its ravages are chiefly confined to the peach; but, at Queenston, specimens were found in both cherry and plum. There are at least two broods in the year. The perfect beetles hibernate in shallow galleries in the bark; they are active very early in the spring, and on warm days, even in February and March, come out of their burrows. Mr. Fisher wrote me on March 13th last: "I examined the trunks of the trees, as you suggested, on a sunshiny day, and found beetles crawling with their wings set for flying. As you know, ordinarily they do not appear as if they had wings; but these had them out ready for use. The presence of this insect is conspicuously evident in wet weather, when enormous quantities of gum ooze from the trunks and fall to the ground. The work of both the larvæ and the perfect beetles seems to be confined, at Queenston at any rate, to the bark. Not a single instance of penetration of the wood could be found, although this latter attack is recorded by some observers.

The remedies which have been tried are, washing the trunks with kerosene emulsion, linseed oil, and whitewash containing Paris green. The results have been rather conflicting, but there is every reason to think that before long a sure means of prevention will be found.

Another insect, which was received from the Queenston district, and also from Fenwick, Ont., is the Otiorhynchid beetle (*Anametis grisea*, Lec). Mr. Fisher found specimens upon his peach trees, but was under the impression they did not do him much harm. Mr. E. S. Atkins, of Fenwick, however, suffered more severely; he writes: "Last year they killed 130 young peach trees for me, and ate out four rows of strawberries extending across a six-acre field. They only attack the very first leaf-buds and the bark of the young trees when first set out; or when a young tree is budded and cut off near the ground, by eating the bud they destroy the tree. In many of their habits they resemble the potato beetle, such as letting themselves drop to the ground and lying apparently dead; and in warm sunny days they move about and eat, and on cold or wet ones they lie concealed at the root of the tree in the earth. When the beetles are most destructive, there is nothing to spray, as the top is cut off, and it is a mere switch with nothing to hold the mixture." As these beetles are wingless, and have to climb up the stems of trees to attack them, any mechanical means of prevention, such as a band of cotton batting or one of the various kinds of tree protectors, placed around the trunks at the time the perfect beetles occur, would prevent injury by the mature insects. In the case of young budded stock, a strip of tin bent into a ring about four inches in diameter, and pressed into the ground around the base of the stem, similar to those now so generally used by gardeners for cut-worms, might be serviceable.

I am informed by Dr. J. Hamilton that he has bred this beetle in Pennsylvania from the stems of the Rag-weed, *Ambrosia trifida*, where the larva had lived as a borer; but I think it must have some other larval habit in Canada, as this plant is only an accidental weed in a few places in Ontario.

The Spotted Paria (*Paria sexnotata*, Say,) is another beetle which requires mention as a serious pest of the raspberry. It has given great trouble on some of the fruit farms in the neighbourhood of Grimsby and St. Catharines for several years past. It was first brought to my notice by Mr. Martin Burrell, of St. Catharines, and was so difficult to control that he eventually ploughed out the whole of the infested patch. He wrote in 1892: "My old enemy, *P. sexnotata*, has revisited me this spring in greater numbers than ever. I sprayed with Paris green, 4 ounces to 30 gallons, but the foe still 'bobbed up serenely.' Of a quarter of an acre of my raspberries not a score of canes have leafed out. I am not the only victim this year, as several of my neighbours have been severely injured by the beetles."

Mr. John Craig, Horticulturist, of the Central Experimental Farm, found this insect also very abundant early in May, in raspberry plantations on the road between Hamilton and Grimsby; and Mr. Linus Woolverton, the energetic secretary of the Fruit Growers' Association of Ontario, sent me last spring specimens, with the report that they were doing much harm about Grimsby by eating out the fruit buds of raspberries, and thus destroying the crop. The following answer was sent to him: "The beetles you send are the Spotted Paria. This is a most injurious insect, and has done much damage in the way you describe, at St. Catharines. It seems to be very difficult to kill. I would suggest your dusting the raspberry bushes at once with Paris green and slaked lime, 1 pound of Paris green to 25 of lime. This mixture is easiest applied by putting it in a bag of cheese-cloth and shaking or tapping it over the bushes. Of course, if you can get a morning when there is a dew on them, so much the better. The beetles may also be killed in large numbers by beating or shaking them off the canes into an open pan containing water, with a little coal oil on the top. A good plan for collecting them is to hold an open and inverted umbrella beneath the canes when beating them, and then brush the insects out into the coal oil pan."

The Spotted Paria does not confine its attacks to the raspberry alone, but is occasionally troublesome to strawberries. In 1874, Mr. John McGrady, of Gatineau Point, Que., suffered a disastrous attack upon his strawberry beds. He found that hellebore was quite useless against the enemy; and my experience is that much stronger poisons are necessary for this beetle than for many others.

There have been, of course, many of the well-known fruit pests complained of from various parts of the province, but, with perhaps the exception of the Bud Moth in the Grimsby and London districts, and *Bucculatrix pomifoliella* in western Ontario, no others demand special mention here.

SIXTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The Association met at 10 a.m. in Room 12 of the Packer Institute, Brooklyn, N.Y., August 14th, 1894. The following officers and members were present:

President, L. O. Howard, Washington, D. C; Vice-President, J. B. Smith, New Brunswick, N.J.; Acting Secretary, O. L. Marlatt, Washington, D.C.

Messrs. William H. Ashmead, Washington, D.C.; Geo. F. Atkinson, Ithaca, N.Y.; Nathan Banks, Sea Cliff, N. Y.; D. W. Coquillett, Washington, D.C.; Geo. C Davis, Agricultural College. Mich.; A. D. Hopkins, Morgantown, W.Va.; Geo. H. Hudson, Plattsburg, N.Y.; J. A. Lintner, Albany, N.Y.; V. H. Lowe, Jamaica, N.Y.; F. W. Raine, Morgantown, W.Va.; William Saunders, Ottawa, Canada; E. B. Southwick, Central Park, New York City; F. A. Sirrine, Jamaica, N.Y. There were also in attendance upon the meetings visitors and members of other scientific societies, the average attendance being twenty-five persons.

The meeting was called to order by the President, and in the absence of the Secretary, Mr. Gillette, Mr. O. L. Marlatt was elected Secretary for the meeting.

The President, Mr. Howard, then delivered his annual address as follows:

A BRIEF ACCOUNT OF THE RISE AND PRESENT CONDITION OF OFFICIAL ECONOMIC ENTOMOLOGY.

By L. O. Howard, Washington, D. C.

When this Association was founded, in 1889, the name adopted was "The Association of Official Economic Entomologists," and its objects as outlined had evidently especial reference to the work of those economic entomologists who hold official positions. At the first annual meeting, held in Washington in November of the same year, Dr. Lintner, with the evident idea of broadening the scope of the Association, introduced an amendment to drop the word "official" from the title, and this amendment was adopted at the meeting at Champaign, Ill., the following year. Notwithstanding this fact, the membership of the Association is to-day largely official; out of 73 members 60 hold official positions, while the active work is all done by those with whom economic entomology is a means of subsistence. At the last meeting, held in Madison, Wis., in August, 1893, every member registered belonged to the official class.

The organization meeting at Toronto on the 30th of August, 1889, presented a strange contrast to this. It was held, as may not generally be known, upon a wooded knoll at a landing called Scarborough Heights, overlooking the waters of Lake Ontario. The beach below and the woods around were being scoured by industrious collectors of the old section F, of the American Association for the Advancement of Science. Professor Cook, who presided, occupied a dignified position astride a fallen log. Dr. Smith, who acted as secretary, had climbed with difficulty to the top of a tall stump and took his minutes on his knee. Dr. Bethune, Mr. Fletcher. Mr. E Baynes Reed, Mr. H. H. Lyman, Prof. C. W. Hargitt, Mr. E. P. Thompson, and the writer reclined with more or less grace, according to their physical conformation, upon the ground or sat cross-legged upon convenient ant-hills This group, which made the Association "official" in name, was composed of four official entomologists and five who were simply interested workers.

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*Through the kindness of Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, D.C., and Mr C. L. Marlatt, Acting Secretary of the meeting, who prepared an abstract of the proceedings for the *Canadian Entomologist*, we are enabled to give the following account of this interesting meeting as well as some of the papers in full.—Ed.

This brief historical paragraph is introduced for the purpose of showing the interesting paradox that this Association was originally made official by non-officials, that it was subsequently made non-official by officials, and that since it was made non-official it has become more official than before.

It is in part for this reason that I have chosen to bring together for presentation at this meeting some account of the rise and present condition of official economic entomology, but more largely for the other reasons that few of us probably have been able to take a comprehensive view of the status of our application of entomology the world over, and that a review of what has been done can not but justify our existence as a class and as an association and afford the strongest of arguments for the increase of our numbers and for increase of means and facilities.

The ravages of insects on cultivated plants were doubtless coetaneous with the beginning of the cultivation of plants. Thus a necessity for economic entomologists existed at a very early time. The condition of the ancient husbandman with reference to injurious insects is voiced by the prophet Joel, when he says:

> That which the palmer-worm hath left, hath the locust eaten; and that which the locust hath left hath the canker-worm eaten; and that which the canker-worm hath left hath the caterpillar eaten. * * * He hath laid my vine waste and barked my fig tree; he hath made it clean bare and cast it away; the branches thereof are made white * * * The field is wasted, the land mourneth. * * * Be ye ashamed, O, ye husbandmen; howl, O, ye vinedressers, for the wheat and for the barley, because the harvest of the field is perished.

In 1881 Dr. Hagen published in the columns of the *New Yorker Belletristiches Journal* (August 16) an interesting article entitled "Heuschrecken Kommissionen im Mittelalter und heute," in which he showed that grasshopper invasions have taken place since time immemorial, and that man's efforts to combat them have always ended in his discomfiture. It is not surprising, therefore, says Dr. Hagen, that the helpless multitude called on the intervention of the law and of God to deliver them from such pests; and the legislators on one side and the priests on the other were forced to carry out the will of the people. But since written laws and legislative decrees against elemental plagues would have been ridiculous without a surrounding of imposing, legally regulated forms, the development of these formalities gradually reached a high degree of perfection. Legislation for defense against injurious animals reached its highest development in the Middle Ages. Legal procedures against all sorts of noxious animals were frequent, and the famous Burgundian legal light, Bartholomæus Chassanæus, wrote a book setting forth the rules according to which a suit against grasshoppers should be entered. After a court had been called together by written request, a judge was appointed and two lawyers were elected, one to plead the cause of the people and one the cause of the accused grasshoppers. The former commenced by formulating the charge, and concluded by requesting that the grasshoppers be burned. The defendant's lawyer replied that such a request was illegal before the grasshoppers had been requested in due form to leave the country. When, however, they had not left the country after a stated term, they could be excommunicated. Many years afterward, another jurist, Hiob Ludolph, wrote a pamphlet antagonizing Chassanæus's work, setting forth the lamentable legal ignorance displayed by the latter. The accused grasshoppers, said Ludolph, must be summoned four times before the court, and if they do not appear, then they should be dragged by force before the court. Then only can the suit proceed. Other interested parties, however, shall be heard, namely, the birds that feed on the grasshoppers. Further, it would be a great injustice to banish the grasshoppers into adjacent territories Finally, the code proposed by Chassanæus can never be brought into accordance with the laws and rules of the Church, because there is absolutely nothing in those laws about suits against grasshoppers.

Several suits against injurious insects were brought before the courts, and the rulings have been preserved. In one case (1479) a suit was brought against injurious worms, apparently cut-worms, in the canton of Berne, Switzerland. The worms, although ably defended, lost the suit, and were excommunicated by the archbishop and banished. Regarding the effect of this awful punishment, the chronicler who relates the story adds: "No effect whatever resulted, evidently on account of the great depravity of the people."

In various other law suits the chroniclers fail to mention the final outcome; but, says Hagen, it is safe to surmise that in the whole history of jurisprudence there was never a greater disregard for the rulings of the courts on the part of the guilty parties than during the time of the mediæval insect commissions.

To attempt to enumerate the different commissions which have been established, particularly by European countries, against particular outbreaks of injurious insects, and especially against locusts, which have entered Europe from the south and from the west at intervals for many hundreds of years, would be impossible, and even if possible, would extend this paper far beyond its proper length. I shall be obliged, therefore, to neglect this phase of the subject and confine myself rather to the history of the more prominent organizations of wider scope, and these I shall treat geographically and chronologically, beginning with our own country.

THE UNITED STATES.

MASSACHUSETTS. Dr. Thaddeus William Harris was probably the first American entomologist to receive public compensation for his labors, and in this sense he may be called the first of the official entomologists in this country. In 1831 he prepared a catalogue of insects, appended to Hitchcock's Massachusetts Geological Report. "In the condition of American science at that day," says Scudder, "it was a work of inestimable value, though his only material compensation was one copy of the report and several copies of the appendix." At a later period he was appointed by the State as one of a commission for a more thorough geological and botanical survey. In this capacity he prepared his now classic report on insects injurious to vegetation, first published in full in 1841, the portion upon beetles having appeared in 1838. He reprinted the work under the name "Treatise" instead of "Report" in 1842, and again, in revised form, in 1852. The whole sum received by him from the State for this labor was $175. After his death the work was reprinted by the State in its present beautiful form, with wood engravings which themselves marked an epoch in that art. It is largely upon this work that Harris's scientific reputation will rest, and although prepared more than half a century ago, it is to-day perhaps above all other works the *vade mecum* of the working entomologist who resides in the northeastern section of the country,

From 1852 to 1870 Massachusetts did little or nothing in economic entomology. In the latter year, however, Dr. A. S. Packard, jr., then of Salem, was appointed entomologist to the State Board of Agriculture—without compensation, however, as he informs me. Dr. Packard published three reports covering the years 1871, 1872 and 1873. They were short pamphlets, but were ably prepared, and were undoubtedly productive of very considerable good.

With the founding of the State Agricultural Experiment Station under the Hatch Act, Prof. C. H. Fernald, professor of zoology at the Massachusetts Agricultural College at Amherst, was appointed entomologist to the station. Prof. Fernald's work has been practically like that of most other station entomologists, and he has published several important bulletins. The ones for which there has been the greatest demand are No. 5 on household pests, which was the outgrowth of original studies which Prof. Fernald had made in this direction, and No. 12 containing the work upon the bud moth, spittle insects, and several other injurious species, all based upon original observation. The most important portion of his work has not yet been published. It comprehends the scientific results of his observations as entomological adviser to the gypsy moth committee of the State board of agriculture. That these results will prove of great value the writer is in full position to assert, as he has had the pleasure of seeing many of Prof. Fernald's experiments in the course of procedure, and has been greatly impressed by the ability and care with which they are being carried on. Prof. Fernald has also for some years held the position of entomologist to the State Board of Agriculture.

The work upon the gypsy moth, by the way, which has been done by the State of Massachusetts since 1889 is one of the most remarkable pieces of work, judging by results, which has yet been done in economic entomology. The operations have been carried on by a committee of the State Board of Agriculture and the means have been furnished by rge annual appropriations by the State legislature. Three hundred and twenty-five ousand dollars have already been appropriated. A territory comprising something over 00 square miles was infested by the insect, which occurred in such extraordinary numers as to destroy many trees and almost to threaten the ultimate extinction of living vegtation, not only within the infested territory, but in all localities to which it might read. It is unnecessary to detail the steps by which relief was brought about. Mistakes ere undoubtedly made at first, and it is to the work of the present committee that the ain credit is due. The infested territory has been reduced by one-half, and within the disicts in which the gypsy moth at present exists it is, practically speaking, a comparavely rare species. The future of the insect is, however problematical. The continuance f sufficiently large appropriations from the State legislature to enable the work to be rried on on its present scale is doubtful, yet those in charge believe that still larger ppropriations are necessary to bring about extermination. They are confident, however, at with sufficient means the insect can be absolutely exterminated from the State of assachusetts. With the legislature disinclined to continue the large appropriations, the ethods of the committtee at present pursued will have to be seriously altered. Given a nall appropriation of say $25,000 annually, it will become necessary to adopt some law, ke that in force in California, whereby much less frequent inspection may be made, and e committee will have to rely in part upon voluntary observers for information. Morever, they will be unable to conduct spraying operations upon a large scale, and the expense f the destruction of insects will have to be assessed upon the owners of the property upon hich the insects are found, provided such owners will not themselves undertake the desuction of the insects. There will be many disadvantages from such a course, and in the se of unproductive lands the expense will be so great that the owner will prefer conscation. Between some such course as this and the continuance of the present methods, owever, there seems to be little choice, since if the appropriation were taken away the sect will not only speedily reach its former destructive height, but will spread far and ide over the country. It may be urged that it will be only a few years before the insect ill take its place as a naturalized member of our fauna and will become subject to the me variations of increase and decrease as our native species, and that it will, in fact, ecome little more to be feared than species already existing with us, particularly if its uropean natural enemies are introduced. Against this view, however, it must be urged at the gypsy moth seems an exceptionally hardy species and that even in Europe it is a rime pest. The caterpillar is tough and rugged and seems little subject to disease and climatic drawbacks and is wonderfully resistant to the action of ordinary insecticides. he gypsy moth larva will feed for days without apparent injury upon trees which have een sprayed with Paris green or London purple in a solution so strong as to somewhat urn the leaves. In fact, the committee, in the spraying which they are carrying on at resent, have found it necessary to use arsenate of lead in as strong proportion as 10 ounds to 150 gallons of water. The well-known vitality of previously introduced Euroean injurious insects is apparently increased to a striking degree with this species, while e fact that it feeds on nearly all plants renders it a much more serious pest than any of s forerunners. Under these circumstances, therefore, any course other than an energetic nd well-directed effort to keep the insect within its present boundary will be shortsighted the extreme, although it is very doubtful to my mind whether absolute extermination ill or can ever be brought about.

NEW YORK. It is rather a stretch of the facts to classify Dr. Harris as an official ntomologist. The first scientific man to receive a true official commission for the investiation of injurious insects was Dr. Asa Fitch, of New York. The New York State legisture, during the season of 1853-54, made an appropriation of $1,000 for an examination f insects, especially of those injurious to vegetation, and authorized the appointment of a itable person to perform the work. The matter was placed in the hands of the New ork State Agricultural Society, and at a meeting of the executive committee of the ciety, held at the Astor House, in New York City, May 4, 1854, the following resoluon was passed :

> *Resolved*, That Asa Fitch, M.D., of Washington County, be appointed to perform the work ; that he be rnished with such accommodations as he may desire in the rooms appointed for the laboratory in charge f the society ; and that the president and Mr. Johnson, the corresponding secretary, be a committee to preare instructions for such entomological examinations.

Mr. William Kelly, at that time president of the New York State Agricultural Society, and Mr. B. F. Johnson, its corresponding secretary, performed their duties in the preparation of these instructions in the most admirable manner. In fact, so well were they performed that we imagine Dr. Fitch himself may have drafted the report which was signed by these gentlemen. So far as we are aware, no subsequent appointment of an official entomologist has ever been accompanied by such a full, explicit, and able paper, and for this reason we quote it in full :

> As our State has had a thorough examination made of all branches of its natural history except its insects, it is of the highest importance that the remaining branch—not less in importance than the others—should receive attention. The committee feel assured that in the selection of Dr. Fitch they have secured a person every way competent to discharge the duties imposed in a manner creditable to the society and the State.
>
> In carrying out this examination it is desirable that equal prominence be given to economical as well as to scientific entomology, that being the part of this science which is specially important to the community at large. It has been objected to the volumes of the Natural History of the State that they are too purely scientific in their character to be of special value to the great mass of our citizens, and in the work now to be performed it is obvious that it will be of very little consequence to know that a particular kind of moth or fly is an inhabitant of this State unless we are also informed of its history and habits, and whether it is a depredator upon any substance which is of value to man. The habits and instincts of our insects are a proper subject of inquiry as much as their names and marks by which they are distinguished from each other. The whole history of every noxious species should at least be traced out as fully as circumstances will permit.
>
> The examiner is therefore directed, in the first place, to make for the present season the insects which infest our fruit trees the leading object of examination. Those infesting our forest trees, our grain and other crops, our garden vegetables, our animals, etc., will remain to be studied hereafter. The examiner is desired in his examinations to search out every insect which is a depredator upon our apple, plum, pear, cherry, peach and other fruit trees, and study out all the facts in the history of each species, both in its larva and in its perfect state, as far as he shall have opportunity to do so. In this way a broad foundation will be laid, to which additions can be made which future observations may show to be necessary.
>
> Should any important insect depredator appear the present season in any other situation than upon the fruit trees, the opportunity for studying it should not be neglected, for the same species may not appear again in many years under circumstances as favorable for becoming acquainted with its real history.
>
> Secondly, what time is not necessarily occupied in examining the insects infesting our fruit trees should be devoted to collecting and classifying the insects of the State, and to naming and describing such species as have not been described.
>
> A report to be prepared at the end of the season, to be submitted to the legislature, showing what has been accomplished during the season, to be divided into two parts. The first, upon economical entomology, giving an account of all that has been ascertained respecting the insects infesting our fruit trees, and any other injurious species that may have been obtained. The second, upon scientific entomology, giving a systematically arranged catalogue of all the insects of the State, so far as they are known, with a brief description of such new and undescribed as may be discovered.
>
> The work should be pursued with a view of eventually securing to the State as full and complete accounts of all the insects of this State as far as to place this important science (which is at the present so greatly in the background, and so partially and imperfectly explored on this side of the Atlantic) in as perfect a position and as favorable a situation for being acquired as its nature will admit of. Should there be time, in addition to the above, to perform other labor, it is desired:
>
> Thirdly, that a commencement should be made in writing out full descriptions of the species pertaining to some particular order, with observations upon the time of appearing, habits, etc., with a view of future publication, so as to secure a complete account of all the insects of the State pertaining to that order.
>
> Lastly, suits of specimens to fully illustrate both the economical and scientific entomology of the State should be gathered in connection with the other parts of this work, to be placed in the Cabinet of Natural History; and in the Agricultural Museum specimens of the wood, leaves and fruits; and other substances depredated upon by each and every species of our noxious insects, showing the galls or other excrescences which they occasion, the holes or burrows which they excavate, the webs or other coverings for themselves which they construct, with preserved specimens of the worms, caterpillars, etc., by which each of these deformities is produced.
>
> Such further examination as Dr. Fitch may deem necessary to carry out fully the objects desired to be accomplished, as from time to time may be deemed advisable, the committee desire may be made.
>
> WILLIAM KELLY,
> B. F. JOHNSON,
> *Committee.*

Dr. Fitch, while not officially designated as State entomologist of New York, was always given this title by courtesy, and continued in office until 1871 or 1872, when his fourteenth report was published, and when the infirmites of age affected him to such an extent that he could no longer continue his investigations. The reports were published in the Transactions of the State Agricultural Society from 1854 to 1870, skipping the years 1859, 1865 and 1868. The first eleven have been published separately, as well as in the transactions of the society. In 1873, through an appropriation by the State legislature, provision was made for the revision and republication of the reports, and the revision was completed by Dr. Fitch. The resolution for printing, however, failed of the concurrence of the senate, and since that time the manuscript has been lost.

The value of Dr. Fitch's labors has been very great. In his fourteen reports the great majority of the injurious insects of the State of New York received more or less detailed consideration, and in the majority of cases the life histories of the insects treated were worked out with great care and detail. The remedial measures suggested by Dr. Fitch have, however, been largely improved upon, and the practical value of these reports to day rests almost entirely upon the life-history side.

From the time of the publication of Dr. Fitch's last report, in 1872, the State of New York did nothing for the encouragement of economic entomology until 1881, when the legislature, on April 14, passed an act to provide for the appointment of a state entomologist. The law reads as follows :

No. 316.] SENATE OF NEW YORK,

In Senate, April 14, 1881.

Introduced by Mr. Fowler ; read twice and referred to the committee on finance ; reported favorably from said committee and committed to the committee of the whole.

AN ACT to provide for the appointment of a state entomologist and fixing his compensation.

The people of the State of New York, represented in Senate and Assembly do enact as follows :

SECTION 1. There shall be appointed, by the governor, a state entomologist, who shall be charged with the study of insects injurious to agriculture and of methods for controlling and preventing their depredations.

P. 2. The salary of the entomologist shall be two thousand dollars, and he shall render an annual report of his labors and investigations to the legislature and shall arrange for the state museum of natural history a collection of insects taken in the course of his investigations.

P. 3. This act shall take effect immediately.

(Senate No. 316). (I. 520, G. O. 391).

(Chap. 377 of the Laws of 1881. Passed May 26, 1881, three-fifths being present.)

The movement which resulted in the passing of this law was started by the regents of the University of the State of New York at their annual meeting in 1877, and the person appointed to fill the office was Dr. J. A Lintner, a well-known worker in entomology, who, up to that time, had been connected with the State Laboratory of Natural History. Dr. Lintner has held office continuously since 1881. He brought to bear upon his duties a ripe experience and a mind trained in scientific methods. He has published nine reports; the last one covering the year 1892, and only recently distributed. These reports are in many respects models. The great care and thoroughness of the author have hardly been equalled by any other writer upon economic entomology. The form of the reports is most admirable, and the account of each insect forms almost invariably a complete compendium of our knowledge concerning it down to the date of publication. His accounts are also arranged in the most convenient form for reference, a full bibliography precedes the consideration of each species, and the frequent subheadings enable the most practical use of the report. The reports are replete with sound and ingenious practical suggestions, and are written in a straightforward, simple style, which possesses great literary merit. They abound in illustrations, and are made available by most complete indices and tables of contents. Aside from these reports, Dr. Lintner has published a great deal in the newspapers, particularly the "Country Gentleman," on the subject of economic entomology, and another valuable feature of his reports is the comprehensive list which he publishes each year of his unofficial writings.

The Cornell University Agricultural Experiment Station was established by the authorities of the university in 1879, and its first annual report contained a series of miscellaneous entomological observations by the acting professor of entomology Dr. W. S. Barnard. The second report, issued in 1883, contained an elaborate monograph of the Diaspinæ by Prof. J. H. Comstock, and an important article on the Tineidæ infesting apple trees by Mr. A. E. Brunn, a student of the Department of Entomology. With the establishment of the agricultural experiment stations under the Hatch bill, in 1888, this experiment station became governmental in its character, and Prof. Comstock was naturally made entomologist. Since that date he, or his assistants, have published a number of very important bulletins, the first one, on "A Sawfly Borer of Wheat," by Prof. Comstock; the second on Wireworms, by Prof. Comstock and his assistant, Mr. M. V. Slingerland, and the later ones mainly by Mr. Slingerland. These are among the best and most practical of the experiment station bulletins that we have. They are characterized by almost a superabundance of detail and plainly by great care. The illustrations are very nearly all original, and are excellent.

THE U. S. DEPARTMENT OF AGRICULTURE. Almost simultaneously with the appointment of Dr. Fitch to do entomological work for the State of New York, came the appointment of an entomological expert under the General Government. On June 14, 1854, Mr. Townend Glover was appointed by the Commissioner of Patents to collect statistics and other information on seeds, fruits and insects in the United States, under the Bureau of Agriculture of the Patent Office. Mr. Glover was one of the most eccentric individuals who have ever done important work on North America insects. He had led a roving and eventful life as a boy in Brazil, as a clerk in a draper's shop in England, as an artist in Germany, as a roving traveller and naturalist in all parts of the United States, and finally as a landed proprietor with horticultural tastes on the banks of the Hudson in New York. Pomological interests brought him to Washington shortly before the time when he received his appointment. His first report was published in the Report of the Commissioner of Patents for 1854, was illustrated by six plates engraved on stone by the author and comprised some consideration of the insects injurious to the cotton plant, wheat, and the grapevine, and on the plum curculio, codling moth, and peach borer, closing with some account of the more common species of beneficial insects. His second report, in 1855, continued the consideration of the cotton insects, together with some accounts of orange insects. The reports for 1856 and 1857 contained nothing from him, but that for 1858 contains a rather full report on the insects frequenting orange trees in Florida, published over the initials D. J. B., which were those of the then chief clerk of the Bureau, with whom Mr. Glover had many serious disagreements, largely on the matter of credit, which resulted in his resignation the following year. In 1862 the Department of Agriculture was established as a separate institution, under the commissionership of the Hon. Isaac Newton, and in 1863 Mr. Glover was appointed entomologist to the Department. His annual reports follow consecutively from 1863 to 1877, and are storehouses of interesting and important facts which are too little used by the working entomologist of to-day. Their value for ready reference, however, is detracted from by a lack of systematic arrangement and poor paper and presswork, but many observations are to be found in the pages written by Glover which have subsequently been announced by others as original and important discoveries. There is, however, in Mr. Glover's reports, a lack of consecutive and full treatment of any one topic, and the subject of remedies seems seldom to have received original treatment or thought with him. This is largely due to the fact that his reports were matters of secondary importance to him, his main energies being devoted to the building up of a museum for the Department and to the preparation of his most elaborate series of illustrations of North American insects, a work upon which he expended enormous labor, and which unfortunately, up to the present time, has added to his fame nothing but the good opinion of a few of his scientific contemporaries

In 1877 Mr. Glover's health suddenly failed him. His report for that year was largely prepared by his able assistant, Mr. Charles Richards Dodge, who, by the way, is the author of the charmingly written account of Mr. Glover's life, published as Bulletin 18 of the Division of Entomology of the Department of Agriculture. Mr. Glover lived for several years afterwards, but was unable to do further work. He died in Baltimore in 1883, and the writer and Profs. Uhler and Riley were the only entomologists present at the funeral services of this, in many respects, remarkable man.

The year 1878 marked a new era in the governmental entomological work. Prof. C. V. Riley, a comparatively young man, who had already become famous by the admirable work which he had done as entomologist of the State of Missouri, and as chief of the

U. S. Entomological Commission, was that year appointed successor to Mr. Glover by the Hon. William G. Le Duc, then Commissioner of Agriculture. Prof. Riley took hold of his work with his accustomed vigor, and, during the nine months that he remained in office at that time, accomplished a great deal. His report for the year 1878, though short, is by far the most practical one which the Department had published up to that time. On account of a misunderstanding with the Commissioner, Prof Riley resigned his commission in May, 1879, and Prof. J. H. Comstock, of Cornell University, was appointed in his stead. Prof. Comstock remained in office until May, 1881 He completed the investigation of the cotton worm, begun by Prof. Riley, and published a thoroughly practical and useful volume entitled "Report upon Cotton Insects," early in 1880. In addition to this report he published extensive annual reports covering the years 1879 and 1880, which rival in thoroughness and practicality the Missouri reports of Prof. Riley and those which were issued by the Department after his resignation. The report for 1880 is marked by the publication of the results of a preliminary investigation of the insects affecting the orange, and more especially by an elaborate report upon scale insects, which formed the basis of the study of this important and very destructive group of insects in this country. Upon the change of administration in 1881, Prof. Comstock was retired, with a year's commission as investigator, and Prof. Riley resumed charge of the governmental entomological work. From that time until June, 1894, Prof. Riley remained consecutively in office. The work which he has accomplished has been of the highest order, and has been largely instrumental in placing the science of economic entomology in this country upon its present sound footing. During the course of his administration of the office he has published 12 annual reports, 31 bulletins, 2 special reports, 6 volumes of the periodical bulletin "Insect Life," and a large number of circulars of information. He has developed not only the scientific side of the work, but also the practical side. Under his direction advances have been made both in insecticides and insecticide machinery, which are of the most far-reaching importance. The earlier work of Prof. Riley will be mentioned in another place, but it will be appropriate to state here that no other name in the annals of North American economic entomology stands out with the same prominence as his. His work has been called epoch-making, and this expression may be considered justified. His voluntary resignation at this time would be greatly to be deplored, were it not for the fact that, with the restoration of his health, which is confidently to be anticipated, he will resume his labors—in another capacity, it is true, but along entomological lines and with undiminished vigor.

Aside from the work of the Division of Entomology, the General Government has, upon one occasion only, provided for work in economic entomology, as have so many other governments, by the appointment of a special commission. The U. S. Entomological Commission was founded, by authorization of an act of Congress approved March 3, 1877, specifically to report upon the depredations of the Rocky Mountain locust in the Western States and Territories and the best practical methods of preventing its recurrence, or guarding against its invasions. The commission was attached to the U. S. Geological and Geographical Survey of the Territories under the charge of Prof. F. V. Hayden, and the office of chief was filled by the appointment of Prof. C. V. Riley by the Hon. Carl Schurz, then Secretary of the Interior. The other members of the commission, also appointed by the honorable Secretary of the Interior, upon consultation with Prof. Riley, were Dr. A. S. Packard, jr., of Massachusetts, secretary, and Prof. Cyrus Thomas, of Illinois. The commission remained in existence, supported by annual appropriations by Congress of varying amounts, until 1881. It published 5 reports and 7 bulletins. The first two of the annual reports related to the Rocky Mountain locust and allied migratory locusts, and form together probably the most complete monograph of any one insect ever published. The practical end was kept constantly in view, and the reports are thoroughly practical, as well as thoroughly scientific. In the appropriations for the year 1879 the commission was instructed to report upon cotton insects, and the results of the investigation thus brought about are published in the fourth report of the commission on the cotton worm and boll worm—another elaborate volume which cannot be too highly praised from all standpoints. The third report treats of a variety of topics and includes two important monographs, one upon the army worm and the other upon canker worms, while the fifth report contains a full and comparatively exhaustive treatment of the subject of the insects injurious to forest and shade trees. The first, second and third reports are published under the joint authorship of the three commissioners, the fourth under the sole authorship of Prof. Riley, and the fifth under the sole authorship of Dr. Packard.

ILLINOIS. During the regular session of the legislature of Illinois, in the winter of 1866-'67, a law was passed enacting that a State entomologist shall, "by and with the consent of the senate, be appointed by the governor with a salary of $2,000 per annum, for a period of two years, or until his successor is appointed and qualified." This legislation was the result of a petition from the State Horticultural Society, and on May 21, 1867, the society passed the following resolution:

> That the president of the society be authorized to engage B. D. Walsh to immediately commence entomological investigations in relation to horticulture, and be empowered to pay out for that purpose a sum not exceeding $500 from the legislative appropriation. This action is taken in case of failure to appoint.

At a special session of the legislature held in June, 1867, the governor sent in the name of Mr. Walsh for confirmation, but the senate postponed action upon it until the next regular biennial session in the winter of 1868 '69. Hence it follows that Mr. Walsh's first and only report was published as acting State entomologist, his untimely death occuring before his second report was prepared, its preparation having been delayed by a long period of ill-health which preceded the railway accident which was the immediate cause of his demise. Mr. Walsh was a retired farmer and lumber dealer of English university training, who for a number of years prior to his appointment had been industriously studying entomology and had written largely for the agricultural press upon the subject of injurious insects. Although not a naturalist by training, his work showed extraordinary powers of observation, and his published writings, as well as the statements of his contemporaries, indicate that he possessed a remarkable mind. In this connection, however, we have occasion to speak only of his official work as indicated in his one report. In this report, which is now unfortunately very rare, he treated particularly of the insects affecting the grape, the apple and the plum, and to this added, under the head of "Insects affecting garden crops generally," a chapter on the so-called "hateful grasshopper," or migratory locust, (*Caloptenus spretus*). His treatment of the other insects is very thorough and his work in a large part remains standard to-day.

Mr. Walsh's successor, Dr. William LeBaron, a practising physician of Geneva, Ill., well known for his writings on injurious insects in the agricultural journals of the time, and an able and conscientious entomologist, published four reports as appendices to the Transactions of the State Horticultural Society, from 1871 to 1874. The first three treated of miscellaneous insects, mainly those injurious to fruit and fruit-trees, while his fourth report, and part of his third, consisted of the beginnings of a work entitled Outlines of Entomology, of which he completed only the order Coleoptera. This portion however, was executed in the most scientific manner, and was fully illustrated, largely by original drawings by Prof. Riley. It has since been used to some extent in the class room, and has undoubledly been the means of interesting many students in the subject of entomology. Dr. LeBaron's treatment of insects from the economic standpoint was careful and practical. He records in his first report the first successful experiment in the transportation of parasites of an injurious species from one locality to another, and in his second report recommended the use of Paris green against the canker-worm on apple trees, the legitimate outcome from which has been the extensive use of the same substance against the codling moth, which may safely be called one of the great discoveries in economic entomology of late years.

Dr. LeBaron died in harness, I believe, and was succeeded in office by the Rev. Cyrus Thomas, of Carbondale, who published a series of six reports, extending over the years 1875 to 1880. Mr. Thomas at the time of his appointment was a well-known entomologist, who had written extensively for the "Prairie Farmer" and other agricultural newspapers on the subject of economic entomology, and who had published an elaborate monograph of the Acridiidæ of the United States as one of the special volumes of the Hayden survey of the Territories. He started with his first report, a manual of economic entomology for the State of Illinois, including in this report the portion relating to the Coleoptera. In his second report his assistant, Mr. G. H. French, treated of the Lepidoptera, and in his third report Mr. Thomas treated the Hemiptera, monographing the Aphididæ. His fourth report included a consideration of one family of the Orthoptera, namely, the Acridiidæ, and the fifth a paper on the larvæ of Lepidoptera, by his assistant, Mr. D. W. Coquillet, while in his sixth he was obliged, from the force of circumstances to abandon the scheme. The manual of economic entomology of Illinois remains, therefore, unfinished. In the course of the six reports a very large number of insects are treated from the economic standpoint. Mr. Thomas was able to employ several excellent assistants, and the six reports as a whole are very creditable to the State. The last of the six reports shows rather plainly the falling off in Mr. Thomas's interests in the subject of entomology. Its publication was coincident with the close of the work of the U. S. Entomological Commission, and it consists entirely of reports by Mr. D. W. Coquillett and Prof. G. H. French. After its publication Mr. Thomas transferred his labors to the field of ethnology, in which he had long been interested, and he is at the present time one of the able workers in the U. S. Bureau of Ethnology.

Upon Mr. Thomas's withdrawal from office, Prof. S. A. Forbes, director of the State Laboratory of Natural History, at Normal, Illinois, was appointed State entomologist, his commission dating July 3, 1882. Prof. Forbes's attention had for some time been more or less engaged by questions relating to economic entomology. He has held office continuously since that time, and has published six reports, the first one covering the remainder of the year 1882, the second the year 1883, the third the year 1884, the fourth the years 1885 and 1886, the fifth the years 1887 and 1888, and the sixth the years 1889 and 1890. Prof. Forbes's reports are among the best which have been published. They are characterized by extreme care and by an originality of treatment which has seldom been equalled. The practical end is the one which he has kept mainly in view. His experiments with the arsenites against the codling moth and the plum curculio were the first careful scientific experiments in this direction which were made, and his investigations of the bacterial diseases of insects have placed him in the front rank of investigators in this line. His monographic treatment of the insects affecting the strawberry plant is a model of its kind, and the same may be said of his work upon the corn bill-bugs and of his studies of the chinch bug. In fact, whatever insect or group of insects has been the subject of his investigations, he has attacked the problem in a thoroughly original and eminently scientific and practical manner. Prof. Forbes has been able to command the services of a very able corps of assistants, including Messrs. C. M. Weed, H. Garman, F. M. Webster, John Marten, and C. A. Hart.

MISSOURI. In the session of 1867-'68 the legislature of Missouri passed an act establishing the office of State entomologist, and directed that the reports of this officer should be made to the State Board of Agriculture. The first and only appointee to this position was Prof. C. V. Riley, who had at that time become prominent as an entomologist through his writings in the "Prairie Farmer," of Chicago, with which paper he had been for some time connected, and through his editorship, in association with Mr. B. D. Walsh, of the "American Entomologist," of which one volume had then been published. He entered upon his duties April 1, 1868, and published his first annual report in December of that year. From that date there followed annually eight additional reports, the ninth being submitted March 14, 1877, and covering the year 1876.

There is no need of any comment upon these nine Missouri reports before any body of economic or scientific entomologists. They are monuments to the State of Missouri, and more especially to the man who wrote them. They are original, practical, and scientific; they cover a very great range of injurious insects, and practically all the species which were especially injurious during those nine years received full and careful treatment. They may be said to have formed the basis for the new economic entomology of the world, and they include a multitude of observations and intelligent deductions which have influenced scientific thought. The value to the agriculturist, as well as to the scientific readers, was greatly enhanced by the remarkable series of illustrations which were drawn by the author and engraved upon wood by the most skilful wood engravers of that time. Aside from a few of the illustrations to the Flint edition of Harris, they are the best woodcuts ever made of insects in this country, and as a whole the drawing far excels that of the Harris illustrations in its lifelike accuracy, artistic beauty, and closeness of detail. Prof. Riley abandoned his Missouri work on taking up the directorship of the U. S. Entomological Commission, and in pursuance of a shortsighted policy Missouri has never since had a State entomologist.

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In 1884 the Department of Agriculture of Canada established the office of honorary entomologist, and this office was filled by the appointment of Mr. James Fletcher, at that time an employee of the Government Library at Ottawa, and already widely known in entomological circles through his active interest in the Ontario society and his contributions to its publications. On July 1, 1887, Mr. Fletcher was transferred to the staff of the Dominion Experimental Farm at Ottawa as entomologist and botanist. Mr. Fletcher's footing since that date has been practically identical with that of an entomologist to one of our State experiment stations, except that his field is larger. He has published a report yearly in the Annual Report of the Experimental Farms, published as an appendix to the report of the Minister of Agriculture. Mr. Fletcher has shown himself to be a man of extraordinary energy, a most entertaining writer, and a most careful observer, and one who has always kept the practical part of his work foremost in view. He has paid a great deal of attention to a side of his work which is neglected by many of our own official entomologists, namely, personal intercourse with farmers, frequent talks on injurious insects at farmers' institutes, etc., and has in this way built up a very large clientage among the most intelligent agriculturists in the Dominion. In economic entomology Canada at the present day is perhaps in no way behind the United States, and this is largely due to Mr. Fletcher's individual efforts, aided and encouraged as they are by the warm support of the eminent director of the experimental farm system, Mr. William Saunders, himself a pioneer in economic entomology in Canada and the author of one of the most valuable treatises upon the subject that has ever been published in America. Canada has the man and the knowledge, but has been hampered by want of funds. The result is that while she has immediately and intelligently adopted the results of researches made in this country, she has not been able to lead us in original investigation.

EUROPEAN COUNTRIES.

In general it may be said that Europe has not felt the need of entomological investigation from the economic standpoint to anything like the same extent as the United States. A climate much less favorable to the undue multiplication of injurious insects than that of North America, and which, moreover, seems to act as a barrier against the importation of foreign destructive species, the actually smaller number of injurious species and the vastly greater familiarity with all phases of the life-history of these species by all classes of the people, partly resulting from the older civilization, partly from educational methods, and partly from the abundance of elementary and popular literature on questions of this character, the denser population, and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotation of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, have all resulted in a very different state of affairs regarding the damage which may be done by injurious insects. In summarizing these points, the Chief of the Agricultural Section of the Ministry of Agriculture of Prussia, in conversation with the writer last summer, argued that Germany does not need to employ general economic entomologists; that its experiment stations seldom receive applications for advice on entomological topics. Special insects, it is true, occasionally spring into prominence; the Phylloxera is one of these, and in an emergency like the Phylloxera outbreak, the work is handled by special commissions. European nations, therefore, can afford to let the insect problem alone to a much greater extent than the United States, for the reason that it is of infinitely less importance with them than with us. The most simple remedies, such as hand-picking, together with a rigid enforcement of the public regulations regarding hand destruction, usually suffice to keep injurious insects in check. Nevertheless, insect outbreaks do occasionally occur, and there is a certain percentage of loss every year from the work of injurious species. The results obtained in the United States, where the number of native injurious species is much greater than in Europe, and where we have in addition to deal with a host of imported species—in short, where the fighting of insect foes has become an absolute necessity—have, however, acted to a certain degree as incentives, not only to other countries which labor under the same climatic disadvantages as the United States, but even to a certain degree to European countries, where more thorough investigation of injurious insects by competent persons especially appointed for the purpose is gradually becoming thought worth while.*

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GREAT BRITAIN.

There is not and never has been in Great Britain a special government appropriation for work in economic entomology. In 1885 Mr. Charles Whitehead suggested to the lords of the Committee of Council for Agriculture, that it would be valuable to publish reports upon insects injurious to various farm crops. He prepared, and the council published, a series of four reports upon insects injurious to the hop plant, corn and leguminous plants, to turnips, cabbage and other cultivated cruciferous plants, and to fruit crops. In 1886 Mr. Whitehead was appointed agricultural adviser and prepared a report upon insects and fungi injurious to crops of the farm, orchard and garden for 1887-88, and in 1889 the Board of Agricultnre was formed, and Mr. Whitehead was retained as technical adviser, especially with reference to insects and fungi injurious to crops, but also with reference to other agricultural questions. He prepared annual reports on insects and fungi for 1889, 1891 and 1892, and a number of leaflets and special bulletins on insects unusually prevalent from 1889 down to the present time. I learn from Mr. Whitehead, that there is no specific law authorizing this expenditure; that his work has been continuous since 1887, and that he has received an annual sum of £250 only. The more important of the special bulletins and leaflets which have been issued have been: Special Report on an attack of the Diamond back Moth Caterpillar, 1892; Caterpillars on Fruit Trees; Hessian Fly; Moths on Fruit Trees, 1890; Apple Blossom Weevil, Raspberry Moth and the Mangel Wurzel Fly, 1892; Black Currant Mite, 1893; and the Red Spider and Apple Sucker, 1894.

While Mr. Whitehead has, therefore, been the only governmental worker in agricultural entomology, a very considerable work has been done in a semi-official way by an untiring and public-spirited woman, Miss Eleanor A. Ormerod, who is, or rather was, in her official capacity, honorary consulting entomologist to the Royal Agricultural Society. From 1876 to 1893 Miss Ormerod held this position; conducted the correspondence of the Royal Agricultural Society on the subject of injurious insects, and published at her own expense a series of annual reports, seventeen in number, which have contributed very largely to the diffusion of knowledge concerning injurious insects in Great Britain among the farming classes She has had a most conservative class of people to deal with, and has encountered many obstacles. She has shown herself ingenious, careful and receptive to a degree, and at the same time possessed of an enthusiasm and an unlimited perseverance which are calculated to overcome all obstacles. She has studied many of the English crop enemies *de novo*; she has popularized the work of other English entomologists, and has made accessible to the agricultural class the work of John Curtis and Prof. Westwood, and has adopted, and strongly advocated the adoption of, measures found to be successful in other countries, particularly in America. The good which Miss Ormerod has accomplished can hardly be estimated at the present time, but she will deserve, at the hands of posterity, canonization as the patron saint of economic entomology in England.

Aside from her annual reports, Miss Ormerod has published a large work entitled, Manual of Injurious Insects and Methods of Prevention, and numerous smaller works, treating of the Hessian fly, sugar cane insects and the injurious insects of South Africa, the last two being devoted to the agricultural interests of the English colonies.

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* We regret that our space will not permit us to publish the whole of Mr. Howard's address. We are reluctantly compelled to omit his account of the work in foreign countries.—ED.

Within the year the Royal Agricultural Society has made the office of consulting entomologist, or rather zoologist—for they have broadened the term—a salaried one, and Mr. Cecil Warburton, an able student of zoology, although not known as an entomologist, has been appointed to the position. Mr. Warburton has published one report, which is mainly compiled and devoted to extracts from the correspondence of the society, but it is too early as yet to judge of his capabilities from our standpoint.

Miss Ormerod's legitimate predecessor may be said to have been John Curtis, who, from the beginning of Dr. Lindley's *Gardener's Chronicle* contributed an important series of essays upon injurious insects to its columns, under the *nom de plume* "Ruricola." Mr. Curtis's connection with this famous agricultural journal was of great advantage to him, as it enabled him to secure information and specimens from all parts of the kingdom. He had also accumulated a large amount of information during the twenty years he was engaged in writing his great work upon British entomology. When the Royal Agricultural Society of England was founded, in 1840, the council of the Society invited Mr. Curtis to prepare a series of reports upon the insects affecting various crops cultivated in Great Britain and Ireland, and in the Journal of the Royal Agricultural Society for the years 1841 to 1857, he published a series of sixteen such reports. The matter of these reports, and also of his previously published *Gardener's Chronicle* articles, was drawn upon largely for, and in fact forms the major portion of, his standard work upon Farm Insects, published by Blackie & Sons, London, Glasgow and Edinburgh, in 1860. Whether Curtis was remunerated for his work for the Royal Agricultural Society or not I am unable at this time to state, although he probably received some compensation. I learn, through the kindness of Miss Ormerod, that, chiefly on account of the value of his writings upon economic entomology, Mr. Curtis was awarded a pension from the civil list, which was augmented about three years before his death, on account of the sad loss of sight which he experienced.

In 1877 a strong effort was made to secure the appointment of a Government entomologist. A conference was held at the Society of Arts, which was largely attended and was presided over by the Duke of Buccleugh, K.G. The most important paper read was by Mr. Andrew Murray, and after a long discussion the conference resolved:

> That much of the loss occasioned by insects is preventable and ought to be prevented; that it properly belongs to government to provide the necessary means for protecting cultivators from this loss, as it is only by simultaneous action over considerable districts that it can be effectually done, and government alone possesses or can obtain the requisite means of indorsing such action; that the president and lords of the Council and the Agricultural Societies of the United Kingdom be informed of the opinion of this conference and urged to take the subject at once into their consideration, with a view to providing a remedy.

While we have no doubt that this conference was of sufficient importance and attracted enough attention to induce the president, lords, etc., to take the subject into consideration, no further action resulted.

IRELAND.

Mr. George H. Carpenter was appointed in 1890 consulting entomologist to the Royal Dublin Society, and has submitted four reports, entitled, Report on Economic Entomology for the year 1890, and the same for 1891, 1892 and 1893. Reprints of these reports from the Reports of the Council of the Royal Dublin Society have been distributed. Mr. Carpenter is assistant naturalist in the Science and Art Museum in Dublin, and I am not informed as to whether he receives special compensation for his work as consulting entomologist.

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INDIA.

Among the English colonies the government of India stands out very prominently in the support which it has given to economic entomology. A most interesting account of the beginning and growth of this work has been transmitted to me by Mr. E. C. Cotes, from which I take, for the purposes of this paper, the following facts:

The present arrangement was the outgrowth of two reports, one on the wheat and rice weevil and the other on insecticides, which were drawn up unofficially in the early part of the year 1888 by Mr. Cotes, at the suggestion of the secretary to the government of India, in the Revenue and Agricultural Department. Mr. Cotes was at that time in charge of the entomological collections of the Indian Museum, and the reports were published by the government, with the consent of the trustees of the Museum, as the first two numbers of an official series entitled Notes on Economic Entomology. The title of this serial was subsequently changed to Indian Museum notes, when the trustees of the Museum consented to charge themselves officially with the conduct of the investigation. The work really commenced in March, 1888, when Mr. Cotes was deputed to attend an agricultural conference at Delhi, where the part to be taken in the scheme by the various provincial governments was discussed. As a result of this conference the departments of land records and agriculture, attached to the various provincial governments, undertook to arrange for the submittal of reports and specimens from officials concerned with agriculture in all parts of India. The task of collating the results, and also of carrying on such investigations as could be conducted at headquarters, was intrusted to Mr. Cotes, aided by a staff of six office assistants, whom he was permitted to select. Circular letters were sent out to all parts of the country, and large numbers of reports and specimens soon began to come in. The results were published from time to time and freely circulated among all interested. One of the greatest of the early difficulties was the identification of species, but this was accomplished mainly through correspondence with specialists in different parts of the world. The results of six years of work are, in brief: The ascertaining of the identity of several hundred of the more important injurious species which affect crops in India. The recording of the nature of the damage occasioned by them, and the tracing out of the main facts in the life histories in a large number of cases. Information has been continuously supplied to officials and planters as to the nature of their insect pests and the most promising methods of treatment. Many experiments have been tried with a view to the adaptation of insecticides in use in other parts of the world to the requirements of special crops under cultivation in India. Fourteen numbers of the Indian Museum Notes, comprised in three volumes, have been published, and a number of special reports have also been sent out; one on the locust of northwest India, and one entitled Handbook of the Silk Insects of India. Two preliminary lesson sheets for use in native schools have also been prepared by the office. A thorough investigation of the insects affecting the tea plant is now in progress. The funds appropriated for the support of entomological investigation have varied from year to year; the only special grant for the purpose is one of 5,000 rupees per annum from the government of India. This is paid to the account of the Indian Museum, and forms a part of a general fund which is distributed at the discretion of the trustees, partly for the maintenance of the institution and partly for the support of the work carried on in various departments, one of which includes economic entomology. The work was at first looked upon in many quarters as a matter of comparative insignificance, but Mr. Cotes informs me that its importance is now very generally recognized, and that strong representations are being made in influential quarters, urging the desirability of extending the scope of the work, and making it, like other branches of research, an integral portion of the Agricultural Department of the government. The work which has so far been done by Mr. Cotes and his assistants has been admirable, and we know of no more interesting publication upon entomology than the Indian Museum Notes.

SOUTH AFRICA.

The *Agricultural Journal*, the official organ of the Department of Agriculture of Cape Colony, has been paying a great deal of attention to economic entomology during the last four or five years. The so-called Australian bug (*Icerya purchasi*), the grapevine Phylloxera, and the injurious locusts seemed to have roused the colonists to the necessity for more or less investigation, and the Agricultural Department has taken hold of the matter with some little energy. No distinctively official entomologist, however, was ever appointed. Privately Mr. S. D. Bairstow and one or two other colonists have made certain investigations, and their correspondence with Miss Ormerod, honorary consulting entomologist to the Royal Agricultural Society of Great Britain, resulted in the publication of Miss Ormerod's little book, entitled Notes and Descriptions of a Few Injurious

Farm and Fruit Insects of South Africa, with Descriptions and Identifications of the Insects by Oliver E. Jansen. Prior to the publication of this work Miss Ormerod published a leaflet entitled Observations on the Australian Bug, treating the insect from the South African standpoint. For several years, from 1889 to 1893, Mr. Louis Peringuey, an officer of the South African Museum at Cape Town, was employed as entomological adviser to the Department of Agriculture, and drew £100 per annum for his services. His duties in the Museum, however, did not permit him to devote anything like his entire time to entomological work, and in his advisory functions he chiefly answered questions as to the names of insects and the best remedies for insect pests. Acting upon his advice, the government attempted to stamp out the phylloxera by means of the bisulphide of carbon treatment, but without success, and he resigned his office in 1893. Since that time, and in fact for some time previously, the director of the Botanic Garden at Cape Town, Prof. P. MacOwan, a man of very wide information, although not a trained entomologist, has answered entomological questions for the government. His communications, most of them subsequently published in the *Agricultural Journal*, show him to be a clear-headed, practical man, and it is a pity for the interests of the colony that he is too much interested in his garden and botanical work to take up economic entomology as a study. Mr. MacOwan modestly writes, under date of April 11, 1894:

> Unfortunately, I have been in the habit of reading everything that comes in the way and indexing it, so that really they consult my indexes. It is only thus, in the rough, practical way that a garden director, in a dozen years, gets some acquaintance with injurious and beneficial insects that I have answered questions of economic entomology. I only know what I have seen and fought against in the Botanic Garden, and anybody is welcome to such experience. . . . I only wish we could get some such man as seems to be raised easily in the States to do practical science work in the love of it.

AUSTRALIA.

The Australian colonies of Victoria, New South Wales, Queensland, South Australia and Tasmania have all interested themselves to a very considerable extent in the subject of economic entomology. With an energy and receptivity to new ideas akin to our own, their agricultural societies and departments of agriculture have not been content to allow injurious insects full sway, but all have, in one form or another, made efforts to remedy the damage.

TASMANIA. The earliest attempts were made in Tasmania nearly twenty years ago, when the Codling-Moth Act was introduced in the legislative assembly. The provisions of this Act were quite as wisely drawn as those of any subsequent injurious-insect legislation. It was not until 1891, however, that a definite council of agriculture was established by this colony, and not until 1892 that an official entomologist was appointed. In February, 1892, Rev. Edward H. Thompson, a clergyman of the Church of England and a naturalist of very considerable attainments, who had made himself prominent in this connection by his writings for the local press, was appointed entomologist and pathologist to the Council of Agriculture. Authority for the appointment was given in section 13, clause 1, of the Council of Agriculture Act, and reads as follows:

> 3. To employ from time to time, with the approval of the governor in council, persons competent to give instructions of a practical character in matters pertaining to agricultural and horticultural science, and to arrange for occasional lectures on subjects of interest to cultivators of the soil.

Mr. Thompson's annual compensation was fixed at £300, which in 1894 was reduced to £270, in pursuance of a policy of general retrenchment. The entomologist has charge of no funds for expenses, and up to the present time has been allowed no assistants. Very considerable interest has been aroused, however, in the subject of economic entomology. Mr. Thompson has lectured upon insect pests throughout the colony, and during 1893 received nearly 1,500 letters of inquiry. A little volume of 100 pages, entitled Handbook to the Insect Pests of the Farm and Orchard; their Life History and Methods of Prevention, Part I., has been published, and will be followed by others in the same line, provided the appropriations continue.

NEW SOUTH WALES In New South Wales there was started in 1890 an important publication under the Bureau of Mines and Agriculture, entitled *The Agricultural Gazette* of New South Wales. To this periodical Mr. A. Sidney Olliff, entomologist to the

Australian Museum at Sydney, has contributed many important articles on entomological subjects, which have resulted from his appointment to the charge of the entomological branch of the Department of Mines and Agriculture. Whether Mr. Olliff receives a separate compensation for his work in this direction from the Department, aside from his salary as an officer of the Museum, I have been unable to learn. The prominence given to entomological matters in the *Gazette*, however, is an indication of the live interest taken in the subject. In a series of entomological bulletins, begun in 1892, Mr. Olliff's name appears on the title page as "Government Entomologist, New South Wales." Another able entomologist is employed in the Technological Museum at Sydney, in the person of Mr. W. W. Froggatt, who has, under the "Technical Education Series" of leaflets, published at least one important paper bearing upon economic entomology, which has reference to the damage done to boots and shoes by *Anobium* (*Sitodrepa*) *paniceum*.

QUEENSLAND. In Queensland there is at the present time no official entomologist, although one of the best bits of printed matter relating to economic entomology which has been issued by any of the Australian colonies emanated from the Queensland Department of Agriculture. In 1889 there was published a report on insects and fungus diseases by Henry Tryon, who held, and probably still holds, the position of assistant curator of the Queensland Museum at Brisbane. This is a thoroughly practical and very able report, covering some 250 pages, and contains a great amount of important information. The report is designated as No. 1 upon this subject, but No. 2 has, unfortunately, not yet been published. The occasional bulletins issued by the Queensland Department of Agriculture, giving an account of the agricultural conferences held in different districts of the colony, show a very live interest in the warfare against insects, and this has been particularly the case since Prof. E. M. Shelton, an Englishman by birth, but since his early boyhood a resident of America, and long engaged in agricultural teaching and experimental work here, was employed by the Queensland government as instructor in agriculture in 1890. The Department has begun the publication of a series of bulletins giving the results of recent experiments made at the American agricultural experiment stations, edited by Prof. Shelton, in which late entomological information is given.

SOUTH AUSTRALIA. The first work on injurious insects in South Australia was done by Mr. Frazer S. Crawford, a practical man of wide reading, who interested himself for some years before his lamented death in the study of insects and fungus pests. He read an important paper, under the title of "Insects and fungus pests," before the first congress of agricultural bureaus of South Australia in March, 1890, illustrating the paper by careful drawings done and engraved by himself. It is likely that, had Mr. Crawford lived, he would have been appointed official entomologist to the colony of South Australia. Since his death, however, a vivid interest in the subject has been kept up, largely through the interest shown in the matter by *Garden and Field*, an important agricultural newspaper published at Adelaide, the editor of which, Mr. W. C. Grasby, has visited this country, and is very appreciative of the work which has been done in the United States. The government viticultural expert, Prof. A. J. Perkins, is also a man of some entomological knowledge, although his researches have mainly been connected with the subject of insects injurious to the vine.

VICTORIA. In August, 1890, a conference was held at Melbourne, Victoria, with representatives from the board of viticulture, the council of agricultural education, the different horticultural societies, and wine and fruit growers' associations, for the purpose of considering means for the suppression of insect pests injurious to vegetation; and partly as a result of this conference and further agitation, Mr. Charles French was, in 1891, appointed entomologist to the government of Victoria, under the Department of Agriculture of the Colony. Mr. French's work is largely included in the two parts of an important handbook of the Destructive Insects of Victoria, the first part published in 1891 and the second in 1893. These reports are written in a popular style, and much attention is given to means of destruction. Their distinguishing feature, however, consists in their illustrations, which are colored, and many of which are very lifelike.

THE BRITISH WEST INDIES.

Injurious insects in the British West Indies have only recently received official or semiofficial attention, with the single exception that in the year 1801 a special commission composed of members of the general assembly of the Bahamas was appointed to investigate the damage done to the cotton crop by the red bug (*Dysdercus*, probably *suturellus*) and the chenille (*Aletia xylina*). Within the past two or three years, however, several of the islands have taken up the subject, with or without governmental support, and there is now a rapidly increasing spirit of investigation.

JAMAICA. In the appointment of Mr. T. D. A. Cockerell, a well-known entomologist, to the office of curator of the Institute of Jamaica, at Kingston, it was specially desired that the appointee should conduct investigations in economic entomology and answer all correspondence in this direction which might come in from planters. Upon taking charge of his new office, in June, 1891, Mr. Cockerell was immediately struck by the extraordinary abundance of scale insects in Jamaica, and their importance as enemies to many cultivated plants. With his accustomed energy he at once undertook the study of these insects, and has since published many papers about them, which have been contributions to knowledge. He started an interesting series of stylographic notes, mainly about injurious insects, disseminated much information on this subject among the planters, and fostered an interest in the study which it is to be hoped will not die out. He was succeeded in office in June, 1893, by Mr. C. H. Tyler Townsend, formerly an assistant in the Division of Entomology, U. S. Department of Agriculture, and entomologist to the State Agricultural Experiment Station of New Mexico, who, during the short time of his residence in Jamaica, followed in the lines laid down by Mr. Cockerell, and published a number of very interesting notes, both in the journal of the Institute and in the stylographic series of notes, which he continued. Mr. Townsend resigned in May of the present year, and we have not heard that his successor has been appointed.

LEEWARD ISLANDS. Although no officially designated entomologist is employed by the Leeward Islands, Mr. C. A. Barber, superintendent of agricultural for these islands, is a well-informed man, a trained botanist, and fully alive to the importance of entomological work. He has conducted some important investigations on the sugar-cane shot-borer and other sugar-cane insects, which have been published in the Leeward Islands *Gazette*.

TRINIDAD. No official recognition of economic entomology has yet been reached in this island, but a very active organization, known as the Trinidad Field Naturalists' Club, has been established, which is well worth mention in this connection, since its president, Mr. H. Caracciolo, and its secretary, Mr. F. W. Urich, have interested themselves especially in the subject of economic entomology and are laboring to interest the government. His Excellency the Governor occasionally attends the meetings of the club, and by the institution of prizes for essays and by similar means, a widespread interest in economic entomology is being aroused. The appointment of an official entomologist is probably a matter of only a short time. *The Journal of the Field Naturalists' Club* is an interesting periodical, full of entomological information, and is now in its second volume.

NEW ZEALAND.

New Zealanders have for some time been fully alive to the importance of the study of economic entomology. They have passed laws concerning the destruction of the codling moth and have made an effort to establish quarantine regulations against the introduction of infected substances from abroad. No governmental entomologist has been appointed, although the Department of Forestry and Agriculture published, in 1887, a monograph of the Coccidæ, by Mr. W. M. Maskell, registrar of the University of New Zealand, the title page of which reads: "An Account of the Insects Noxious to Agriculture and Plants in New Zealand." A second part of this account was promised in an introductory note, but has not appeared. Mr. Maskell has also written upon injurious insects in some of the New Zealand newspapers. Much credit is due to a corresponding member of this society, Mr. R. Allan Wight, of Auckland, for the public-spirited interest which he has taken in economic entomology. Nearly every number of the *New Zealand Farmer* for several years has contained lengthy articles from his pen, and he has travelled a great deal for the purpose of lecturing before fruit growers' associations and other farmers' organizations. The editor of the *New Zealand Farmer* has also helped the good work along, and has published editorially a number of articles upon the subject. New Zealanders are agitating the question of the appointment of an official entomologist, but at this date seem to have little hope of immediate success.

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IN CONCLUSION.

In concluding a review of this character, an American writer may perhaps be pardoned for an exhibition of national pride. Writing in 1870, Dr. A. S. Packard, in his first annual report upon the Injurious and Beneficial Insects of Massachusetts, compared the attention paid to economic entomology in this country with that which it received or had received up to that time in Europe, very much to our own discredit. In the twenty-four years which have intervened the change has been vast. All of the great advances in our science have come from America, and it may justly be said that, aside from the one department of forestry insects, the whole world looks to America for instruction in economic entomology.

These great advances, we must remember, would not have been possible without legislative encouragement. Activity on the part of workers and appreciation on the part of the people and their representatives have gone hand in hand. At the present time the amount of money expended for work in economic entomology is far greater in this country than in any other. Our regular annual expenditure in the support of entomological offices amounts to about $100,000, very nearly all of which is appropriated by the General Government, $29,000 going to the Division of Entomology of the Department of Agriculture and about $60,000 to experiment-station entomologists. To this amount must be added the large sums expended annually in publishing our reports and bulletins. The sum total thus reached will probably exceed the amount expended in this direction by the entire remainder of the world. Much more is therefore to be expected from American workers than from workers in other countries. The American members of this association must bear this fact in mind, and must realize that with the present rapid increase in interest among other nations nothing but the most energetic and painstaking work will result in the retention by the United States of her present prominent position. In some respects our results, have not been commensurate with our opportunities, but we have certainly justified in vast degree the money expenditure which has enabled us to prosecute our work. Not a year passes in which the sum saved to agricultural and horticulture, as the direct result of our work, does not amount to many times that which the Government appropriates, as has been often shown, and notably by our former president, Mr. James Fletcher, in his most able and interesting address at our Washington meeting in 1891.

In the good which has been accomplished in the way of remedial work against insects, the work of the official economic entomologists greatly exceeds that of all other classes of individuals. They have been investigators and teachers, students and propagandists; they have carried their researches into the fields of botany, bacteriology, chemistry, mechanics, and general zoology. Nearly all of the practical remedies in use to-day have been of their suggestion, and all great advances in recent years have come from their labors. Occasionally a practical agriculturist or horticulturist, unskilled in entomology, has discovered an important remedy, as was the case when Mr. J. S. Woodward sprayed his apple orchard with Paris green for canker-worms and found it to be a remedy for the codling moth; but Mr. Woodward would never have sprayed his trees at all but for the suggestion of Dr. LeBaron several years previously. And then, too, Prof. Cook, making the same discovery independently, was the one who, by his careful experiments, established public confidence in the remedy, and it is to him, more than to any one man, that the country to-day owes the great annual saving from the widespread adoption of this eminently practical remedy.

We have, then, done good work. We have accomplished results which have added greatly to the productive wealth of the world. We have justified our existence as a class. We are now better equipped for the prosecution of our work than ever before, and it may confidently be expected that the results of the closing years of the century will firmly fix the importance of economic entomology, in the minds of all thinking men of all countries.

On motion of Dr. Lintner, the thanks of the society were unanimously extended to the president for the admirable address presented.

A letter from the secretary, Mr. Gillette, announced that he would be unable to attend the meeting.

The following active members were elected:

F. C. Test, C. E. Chambliss and H. C. Hubbard, all of the Department of Agriculture, Washington, D. C.; Victor H. Lowe and F. A. Sirrine, of Jamaica, N. Y.; and F. W. Raine, of Morgantown, W. Va.

The following persons were elected to foreign membership:

Walter W. Froggatt, Technological Museum, Sydney, N. S. W.
Charles Whitehead, Barming House, Maidstone, Kent, England.
Geo. H. Carpenter, Science and Art Museum, Dublin, Ireland.
Dr. Geza Horvath, Ministry of Agriculture, Buda Pesth, Austria.
Prof. A. Targioni-Tozzetti, R. Staz. d. Entom. Agric., Firenze, Italy.
Prof. A. Giard, 14 Rue Stanislas, Paris, France.
M. J. Danysz, Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
Dr. J. Ritzema Bos, Wageningen, Netherlands.
Mr. Sven Lampa, Entomologist, Dep't. Agric., Stockholm, Sweden.
Dr. N. Cholodkowsky, Institut Forestier, St. Petersburg, Russia.
Dr. K. Lindemann, Landwirthschaftliche Akademie, Moscow, Russia.
Prof. A. Portschinsky, Bur. Entom., Ministère de l'Agriculture, St. Petersburg, Russia.
Mr. E. C Reed, Baños de los Cauquenos, Chile.

Mr. J. B. Smith, New Brunswick, N. J., presented the following paper:

BISULPHIDE OF CARBON AS AN INSECTICIDE.

By J. B. Smith, New Brunswick, N. J.

Bisulphide of carbon as an insecticide of very limited range has been known for many years; but for ordinary field crops it has not been in general use. In the 1893 meeting of the Association of Economic Entomologists, Prof. Garman mentioned that he had used it in the garden, covering melon vines with a tub and allowing a quantity of the bisulphide to evaporate, destroying thereby the aphides infesting the vines. This interested me greatly, because the melon louse, (*Aphis cucumeris*, Forbes,) is at times a most destructive pest in parts of New York and New Jersey, and one of the most difficult to deal with, owing to the fact that the leaves are close to the ground and that they curl as soon as seriously affected, making it simply impossible to reach them all, even with an underspray nozzle. A lot of pot-grown plants becoming badly infested with aphides in the botanical laboratory, I made a series of experiments, which were not recorded, but which determined that the liquid evaporated slowly, that it killed plant-lice very readily, and that it killed plants with equal facility if used in any large quantity. The appearance of the lice on cantaloupe and citron melons in New Jersey gave me an opportunity of making experiments, and Mr. Howard G. Taylor, of Riverton, N. J., kindly permitted me to kill as many hills as might be necessary to carry them on. I procured a dozen wooden bowls thirteen inches in diameter and six inches deep, inside measurement, and a series of small, graduated tumblers, in which "1 teaspoonful" and

"1 dram" corresponded. To get at the rate of evaporation I poured 1 dram into a graduate and left it exposed; but placed in a shaded spot. It required fifteen minutes to disappear completely. Eleven badly infested hills were then covered by bowls, the vines being crowded under when necessary, and 1 dram in a graduate was placed under each. At the end of twenty minutes I lifted one bowl, found that less than half the material had evaporated; that all the Coccinellidæ were dead, the small lice dying, and the Diabrotica, ants, and large viviparous aphides were yet all alive. Ten minutes later there was little change. At the end of three-fourths of an hour, though scarcely more than half the liquid was gone, all save a few of the mature, wingless, viviparous females were dead. In one hour there was yet liquid in all the graduates; but all the aphides were dead, or appeared so. To test the matter, all the hills treated were marked to be examined later. Another series of infested hills were selected; but the experiment was varied by using 2 drams of bisulphide in some cases, using a shallow saucer in others, pouring the liquid on the ground in two cases, and covering other hills with large square boxes, some of them anything but tight. All coverings were left on for one hour, undisturbed. Examined first a square box covering a shallow saucer with two drams of bisulphide; found this all evaporated and every aphis killed. The bowls covering the saucers in which 1 dram was used showed like results. Two square boxes which were not tight, covering graduates with 2 drams of liquid, had all insects unaffected and the material scarcely half gone. The two bowls under which the bisulphide was poured on the ground were then lifted and all the aphides were found dead. All the other hills covered by bowls showed all the lice dead and not all the bisulphide evaporated. The hills first treated were again examined and there was no sign of recovered life anywhere visible. Bowls, graduates and bisulphide were left with Mr. Taylor, and all the treated hills were marked for later examination and to note the effects of the chemical. The experiments were made in the middle of a very hot day, the thermometer 93° in the shade, little or no wind blowing, and the sand so hot that it burned through shoe soles and could scarcely be handled more than a few moments at a time. Many of the hills showed the edges of the leaves, when the covers were removed, yellowed and set with numerous drops of a clear liquid. I feared permanent injury, but instructed Mr. Taylor if he found that the plants died to continue his work before the sun was high or after it was quite low. He wrote me under date of July 19: "The hills you treated when here last started to grow nicely, except the two hills where the carbon was poured on the ground; that killed them. The treated hills showed no lice at last examination." I am quite satisfied, from the experiments above recorded and from others that were not recorded, but were simply made to settle practical questions, that in melon fields at least bisulphide of carbon can be used satisfactorily and effectively. It has the enormous advantage of reaching everything on all parts of the plant, not a specimen escaping. With a stock of from 50 to 100 light covering boxes about 18 inches in diameter, as many shallow dishes, and a bottle of bisulphide the infested hills in a field can be treated in a comparatively short time.

The paper was discussed by various members, Mr. Southwick describing a combination of bisulphide with "Polysolve" which he had used in the form of an emulsion; and Mr. Lintner suggesting the use of cloth coverings in place of the boxes employed by Mr. Smith. Mr. Galloway suggested the use of the protection cloth used by seedsmen, which is treated with oil and is practically air-tight; Mr. Howard referred to the original suggestion by Garman, of the use of a wash-tub, which was thought to be very satisfactory for limited applications; and Mr. Smith and Mr. Saunders suggested the use of paper caps, similar to but smaller than, those used by farmers for the protection of the hay crop. The subject of the relation of parasites to the control of the louse was also discussed, as well as the effect of the bisulphide on the plants themselves, also upon the germination of seeds, when employed for the eradication of grain pests, etc.

AFTERNOON SESSION—AUGUST 14TH, 1894.

The report of the committee appointed last year, on co-operation among station entomologists, was presented by Mr. Smith, in the absence of the chairman. The report covered the matter of concerted work upon the life-history of special insects and their geographical distribution, the selection of certain groups of species to be studied from year to year, co-operation in experimentation with insecticide machinery to avoid duplication, and suggestions in the matter of securing conjoint legislative action among the States. The report was accepted and ordered to be printed, so that opportunity might be afforded members to examine it, in order to be able to take definite action on its adoption at the meeting of 1895.

A letter from Miss Eleanor A. Ormerod was read by the President, in which she expressed her regret at being unable to be present at the meeting

A paper by Mr. J. M. Aldrich, on spraying without a pump, was read in his absence by Mr. Davis. This paper described a scheme for the mechanical mixture of water and oil by the use of an ordinary Nixon climax nozzle, the combination of water and oil being made in the nozzle itself.

In the next paper Mr. C. L. Marlatt gave a review of a number of experiments conducted during the present year with several standard insecticide mixtures, also a series of experiments testing certain of the more important new insecticides or substances which seem to be of value as insect destroyers recently put before the public. The work was mainly to determine (1) the best methods of treating scale insects, (2) the effect of various mixtures on trees and foliage, in both summer and winter applications, (3) to show the relative merits of the old insecticides compared with some of the newer ones, and (4) the possibility of successfully combining insecticides and fungicides.

The paper was discussed by Messrs. Smith, Galloway and others.

Professor Galloway followed with a paper on various insecticide substances with which he had been experimenting for a number of years past, many of them in lines which had not hitherto been worked to any extent. He discussed particularly the kerosene emulsion made with lime, with resin wash, and the Bordeaux mixture. He also described a new method of making resin wash devised by one of his field agents in Florida, which, briefly, consisted in using purer caustic soda, causing a much more rapid formation of the resin soap. Various other mixtures of possible insecticide value were also suggested. The paper was accompanied by the exhibition of a large series of vials illustrating the various mixtures and combinations described by the author. The communication was generally discussed, and the important point emphasized that none of the emulsions were as perfect or as permanent as the standard milk and soap emulsions in common use, although some of them are possibly of value for immediate application.

In the absence of the author the following paper by Mr. Webster was read by the secretary :

SPRAYING WITH ARSENITES *vs.* BEES.

BY F. M. WEBSTER, WOOSTER, OHIO.

At the Rochester, N. Y., meeting of the association, I gave the results of some experiments looking toward a solution of the problem, "Will spraying fruit trees while in bloom affect the bees which afterwards visit these trees for the purpose of securing either honey or any other substance carried to the hives, and if such be the case, what is the effect upon the inmates of such hives ?" The results of my first attempt at settling this question will be found on record in Insect Life, vol. v, pp. 121-123, and it will, therefore not be necessary for me to repeat them here. On account of the meteorological conditions under which the experiments were carried on they have never been deemed conclusive in point of definite results, even by myself, and I have only been waiting a favorable season in order to finish the work. This year the time appeared to have arrived in which I might hopo to solve the problem.

On May 2nd two apple trees in full bloom—and the blossoms were abundant—were thoroughly sprayed with a mixture of 1 ounce of Paris green to each 12 gallons of water. After the water had evaporated the poison could be clearly observed both on bloom and foliage. The application was made during the forenoon, the day being warm and clear, and during the afternoon quite a number of bees were caught while visiting the bloom and marked with carmine ink. The hives were located but a few yards distant from the trees, and both being situated at a considerable distance from any other trees at that time in bloom. None of these marked bees were afterwards found dead about the hives. During the night following the application there was a rainfall of 0.20 inch. On the following day bees were caught and killed by being dropped into a cyanide bottle where the cyanide was embedded in plaster of Paris, after the usual custom. As soon as the bees were dead they were dissected as follows: The posterior legs with pollen attached were severed from the bodies and placed in a small glass vial and securely corked. The contents of the abdomens, including the honey sacs, were next dissected out and placed in a separate vial, and the same mode of procedure was followed with the whole inside of the thorax, this giving me the entire bee except the head, anterior and middle legs, wings, and chitinous walls of the thorax and abdomen. Besides these a number of the bees were kept intact. The whole series was submitted to the assistant professor of chemistry of the Ohio State University, L. M. Bloomfield, to be tested for arsenic by the Marsh method. Mr. Bloomfield found the weight of material submitted in each case to be as follows: Posterior legs, with pollen attached, 0.3498 gram; contents of abdomens and honey sacs, 0.0990 gram; ditto thorax, 0.0710 gram. After the usual tests to prove the absence of arsenic in the reagents it was found that no arsenic was associated with the posterior legs or the pollen with which they were loaded, none had been left in the thoracic matter, but the material from the abdomens gave unmistakable proof of the presence of arsenic. The entire bodies of a number of the bees, taken at the same time from the same tree, were then washed with diluted ammonia water, three washings failing to give a trace of arsenic, but the bodies, after being thus treated, and being boiled in water slightly acidulated, gave distinct traces of the poison, thus eliminating any possibility of the poison having been introduced into the abdominal matter at the time of dissection and from the exterior. May 15th a crabapple tree (*Cratægus*) was sprayed with a mixture of the same ratio of Paris green as before, but in this case only the contents of the abdomens were retained. This matter, to the weight of 0.1463 gram, treated as in the preceding, gave unmistakable proof of the presence of arsenic.

Just at this stage of my investigations, chance, if such a thing there be, threw in my way still more conclusive proof. A few days prior to my last experiment, probably about May 10th, a small apple orchard on the experiment farm was sprayed with Bordeaux mixture, to which had been added Paris green at the rate of 4 ounces to each 50 gallons of the mixture. The bloom had at this time nearly all fallen from the trees the exceptions being an occasional belated cluster. Three colonies of bees, recently brought on to the premises, were located near by, to all appearances in a perfectly healthy condition. A few days after the application of the poisoned Bordeaux mixture one colony suddenly became extinct and a second greatly reduced in numbers, dead bees being abundant about both hives. From these colonies I was able to secure dead bees, and both honey from uncapped cells and dead brood from the hive that had been so mysteriously depopulated. When tested for arsenic by Mr. Bloomfield, precisely as with the other matter, contents of abdomens of the dead bees to the amount of 0.2334 gram revealed the presence of arsenic; 3.7061 grams of honey gave no trace of poison, while 1.8481 grams dead brood showed it to be present, and the entire bodies of the dead bees, thrice washed in ammonia water, as before explained, gave traces of arsenic. In regard to the honey I can only say that it was from uncapped cells, which might and probably did contain last year's honey that was still being used for a partial food supply by the bees.

Briefly recapitulated, arsenic was found present in the contents of the abdomens of bees frequenting recently sprayed blossoms, and we are at least free to assume that more or less of it was contained in the honey sacs. The dead bees three times washed in ammonia water, the latter not revealing the presence of arsenic externally, when tested showed its presence internally. Brood from uncapped cells (larvæ) of a colony suddenly dying without other apparent cause gave evidence of having died from the effect of arsenic which could have been introduced only from without.

In summing up the matter, then, I can see no other conclusion that can be drawn from the results of my experiments than that bees are liable to be poisoned by spraying the bloom of fruit trees, the liability increasing in proportion as the weather is favorable for the activity of the bees, and that all bloom must have fallen from the trees before the danger will have ceased.

Finally, I believe we now have the first conclusive proof of the effect on bees by the use of arsenical poisons in the orchard while the trees are in bloom. Heretofore all has been uncertainty, the statements made being based on either pure assumption, or, as in one instance, on the result of penning up bees and feeding them on poisoned sweetened water. It is certainly to the credit of the entomological fraternity of America that among their number but few could be found willing to risk a positive assertion based on such slender and unreliable information, and I feel that I am fully justified in pointing out the fact that in the case of two of our fellow members, Dr. Lintner and Mr. Fletcher, in the face of the legislative bodies of their respective States, both refused to commit themselves to the extent of making positive statements either one way or the other.

Mr. Lintner said that his position hitherto had been that laws ought not to be passed on the subject unless it was amply proved that harm did result to bees ; and even in that event, the relative interests of the bee-keepers and fruit-growers should be carefully weighed, since it has been showed by him that many harmful insects also visited the blossoms, and they would stand an equal chance with the bees of being poisoned by the arsenical mixtures.

Mr. Smith said that the bee-keepers would always have an advantage when it came to securing legislative action, because, while they represented a comparatively small number of individuals, they are well organized, and can secure action where the much larger body of fruit-growers would be powerless.

Mr. Southwick read the following paper :

ECONOMIC ENTOMOLOGICAL WORK IN THE PARKS OF NEW YORK CITY.

By E. B. Southwick, New York City.

The work of the entomologist of the Department of Public Parks in New York City is the care of trees, shrubs, and plants in an entomological sense, and is under the direction of the Commissioners.

The ground to be covered is about 4,000 acres more or less, but most of the work is confined to the Central and other parks of the city proper. Two men, with the entomologist, constitute the working force, save when the Orgyia cocoons become very abundant, then laborers assist in their removal.

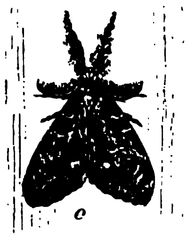

Fig. 56.—The male moth.

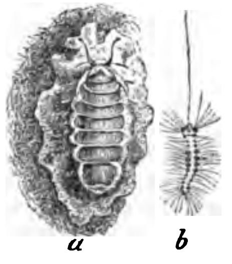

Fig. 57.—(a) The wingless female, (b) a young larva,

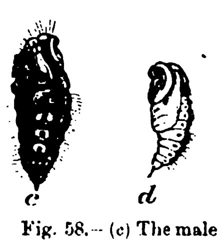

Fig. 58.—(c) The male chrysalis, (d) the female.

The work is continued the year round every day save Sundays and an occasional holiday, A one-horse spraying machine carrying 2½ barrels of liquid is used for the ordinary work of spraying, and a one-horse machine with a powerful force pump for knocking off plant-lice, cottony scale, etc. Various other tools and appliances are used for the removal of egg masses, webs, bag-worm, cases, larvæ, etc. The poisons used are those that are now quite commonly accepted to be the best, viz., London purple, Paris green, kerosene, crude petroleum, crude carbolic acid, bisulphuret of carbon, hellebore, pyrethrum, and others. The insect that requires the most attention the year round is *Orgyia leucostigma*. Fig. 56, the male moth; fig. 57, (*a*) the wingless female, (*b*) a young larva; fig 58, (*c*) the male chrysalis, (*d*) the female. This species is reduced in several ways.

(1) By hand-picking, by which means barrels of the cocoons and egg masses are removed each year. This work is carried on through the entire winter, when all the parks have to be gone over and the trees put in as good condition as possible.

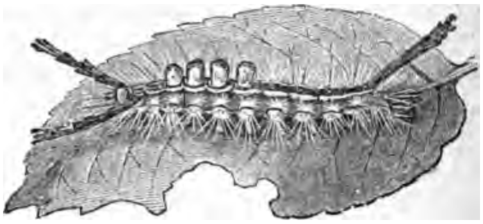

Fig. 59.

(2) By jarring the larvæ (fig. 59) down with a pole so arranged that a blow from a mallet on a projection placed at the larger end of the pole, will jar down any that may be on the limb.

(3) By poisoning the foliage with London purple, which is quite effective, and used especially on very large trees that cannot be treated otherwise.

(4) By spraying the trunks of large trees that are covered with cocoons with an emulsion of petroleum and carbolic acid. This spray put on with force will penetrate most of the cocoons and destroy the pupæ or larvæ within, and many of the eggs that may have been deposited on the outside. This last method is only resorted to when we are unable to subdue them in other ways. Large quantities of the cocoons of this insect are collected each year and taken to the arsenal, where the parasites when bred are allowed to escape from the windows of the building to continue their work of parasitism.

The bag-worm, that at one time defoliated whole sections of the park, has been so subdued that it no longer gives us much trouble. Barrels of their cases have been removed from the trees, and each year we remove all that appear in devastating numbers as far as it is possible to do so.

The European leopard moth (*Zeuzera pyrina*) is one of the worst insects we have to contend with. It works in secret, and not until the damage is done can we locate it. Last season we spent two months on this insect alone, collecting and destroying the larvæ and pupæ. All the affected limbs were collected, the insects removed, and then the limbs were taken to the dump and destroyed by fire, in this way making the work complete. A great many wagon-loads were so collected and destroyed, and this work manifested itself this year in the lesser number of trees affected. This year we continued the work of collecting, but were only able to give two weeks to it, but with the aid of the gardeners we were able to destroy a great many. I believe the work we have done with this insect alone, has saved thousands of trees in our parks that would otherwise have been either destroyed or deformed. This question is a serious one when we are considering such valuable representations of our Silva as are collected in our city parks, for when a limb is amputated by this insect the stub is sure to die, and if the fungus does not immediately take possession of it, it will be amputated by a so-called gardener, who does not see the advisability of protecting the scar from fungi and insects; and here is offered a field for the greedy fungi, whose ever-present spores are ready to grow when the proper field offers itself, and they hardly ever fail to take possession, and all over, our fine elms can be seen with groups of *Agaricus ulmarius* in all stages of growth. This close pruning, without proper protection from insects and fungi, is one of the most important questions of our times, for every year great numbers of trees are destroyed for want of proper protection and a knowledge of seasonable pruning.

UNIVE OF CALIFORNIA

Right here the sap-fly, which I take to be *Mycetobia pallipes*,* finds congenial habitat, and hundreds of trees are weakened by the flow of sap they cause, besides being unsightly from the slimy frass running down their sides. Those we treat with a crude carbolic-acid emulsion sprayed over them; after a time, however, they again show themselves, and have to be treated again.

The elm leaf-beetle is another pest that we have to fight, but with the force of two men, and miles of ground to cover, it is very difficult to keep this insect in subjection. Our success has been in preventive measures rather than otherwise. However, we do successfully destroy them when they have spread over the entire tree. As soon as the first eggs are discovered on the leaves, about the 1st of June, we immediately poison the foliage and keep them from spreading. When the larvæ come down to pupate and collect at the base of the tree, we treat them by spraying with an emulsion of kerosene and crude carbolic acid. In this way we destroy bushels of them, and with the spraying are able to keep them in check in our city parks.

The pine Chermes (*Chermes pinicorticis*) is another insect that is giving us a great deal of trouble, but we can subdue it most effectually with a stiff spray. The tree is then treated with the kerosene emulsion, and also those insects collected or washed down around the base of the tree. This has to be done at least three times a year. For the past seven years I have been using the stiff spray for different work, and it is one of the best means I know of for cleaning maples of Pulvinaria. Three years ago *Pulvinaria innumerabilis* was very abundant on a great number of trees in our parks, and I treated them with the hose and emulsion until I had them in fair subjection. The Chermes and Pulvinaria were at one time taken off with corn brooms, but the spray is much more effectual, and gets in among the small twigs without breaking them.

Scale insects are treated with washes and taken off with steel brushes, and are also sprayed with an emulsion, which covers the smaller branches. *Eriosoma Rileyi* is common on our young elms, and these are treated with the kerosene and carbolic emulsion.

The larvæ of the larger silk producers are collected and destroyed, as well as the cocoons. Datanas are collected by hand, as they are assembled in masses, and destroyed. The web-worm, always abundant in our parks, is collected either by taking down the twigs or, if the tree is a valuable one, by twisting them out and crushing the larvæ.

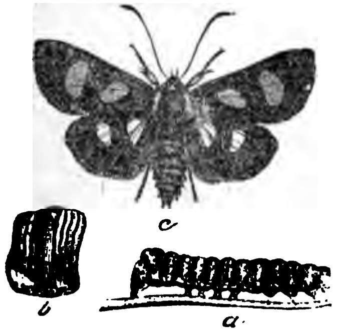

Fig. 60.—(*a*) The caterpillar, (*b*) a segment showing markings, (*c*) the moth.

Alypia octomaculata, fig. 60, (*a*) the caterpillar, (*b*) a segment showing markings, (*c*) the moth), is abundant where Ampelopsis is grown. These are effectually destroyed with the London purple solution.

The catalpa trees have been affected by a species of Cecidomyia, which causes the ends of the branches to turn black and break off. These are collected every year and destroyed before the larvæ leave the twigs. Leaf-skeletonizers are always abundant on many of our trees, and the Platanus and Liquidambar species have suffered most. These insects are cut off as soon as they can be seen working and destroyed. If left for any length of time they make the tree very unsightly.

Aphis species are treated with the kerosene emulsion after the colonies have been broken up with the stiff spray. I have found it impossible to get an emulsion to act upon many of the plant-lice on account of the secretion; but let me play the hose on them a short time and they are disintegrated and demoralized, and many are killed outright by the shock; then a fine spray of emulsion will reach them more effectually than otherwise. The more I have occasion to use a force of water the more I see the benefits that will accrue from it, especially in economic entomological work, for larvæ of many kinds can be knocked down by it, and my men have brought me birds that they have knocked out of a tree and captured.

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*Mr. A. D. Hopkins says it is probably a species of Sciara.—E. B. S.

Other insects that are working on the foliage and in the stems of our plants we have in great numbers, but enough has been said to give an idea of some of the work we try to accomplish. Could we have sufficient force to do the work at the proper time there seems to be no reason why our parks could not be kept in the best condition; but with a force of but two men, with the entomologist, the wonder is that even a respectable showing can be made and the vegetation kept in as good condition as we now find it.

Mr. Howard said that he was very much interested in Mr. Southwick's account of the use of water as an insecticide and referred to some experiments in the same line which he had conducted, in which he showed a strong stream of water to be an effective agent against the rose slug and certain other insects.

Some discussion followed on the nature of the work and the probable species of the sap worm described by Mr. Southwick, which was thought by Mr. Lintner to be probably a species of Sciara.

Mr. Southwick followed with a second paper on the Wood Leopard Moth in the parks of New York, giving an historical account of the insect, its present status, the nature of the injury, the plants affected, and the means he had adopted to exterminate the pest. He stated that this is a most difficult insect to control, and could only be reached by cutting off the affected limb. In the case of rare trees, he had adopted the plan of putting a little bisulphide of carbon in the larval burrow with an oil can, closing the entrance with putty, which had proved an effective remedy.

The paper was discussed by Messrs. Smith, Howard and others.

In the absence of Prof. F. H. Snow, of Lawrence, Kansas, his paper was read by Mr. Victor H. Lowe. This communication, entitled "Work in Economic Entomology at the University of Kansas for the season of 1894," related particularly to the successful work with the chinch bug disease (*Sporotrichum globuliferum*), and a new alfalfa and wheat pest, which proved, on rearing, to be *Agrotis introferans*, Grote.

Mr. Smith reported that the same noctuid had been found by Mr. Gillette to occur very abundantly the present year in Colorado, and Mr. Howard referred to the occurrence of the moth in enormous numbers in Nebraska.

Messrs. Ashmead, Lintner and Hopkins were apppointed by the President a committee to nominate officers for the ensuing year.

MORNING SESSION—AUGUST 15TH, 1894.

Mr. Hopkins presented notes on some discoveries and observations of the year in West Virginia. The paper dealt chiefly with wood-working insects, but also covered various garden pests, such as the potato-scab gnat, the melon plant-louse, etc. The paper was discussed at some length by Mr. Smith, Dr. Lintner, Mr. Raine, and others.

The President read a letter from Mr. Webster, stating that he was unable to be present on account of being actively engaged in stamping out an attack of Fidia larvæ on grape roots, by the use of bisulphide of carbon.

Mr. Howard read a paper on the eastern occurrences of the San Jose scale, in which he briefly reviewed the history of the insect in the United States and showed that as a result of investigations during the winter of 1893-4 and the summer of 1894, the scale has been discovered in six localities in the eastern United States outside of New Jersey, while in the latter State it occurs at many points. He traced the introduction to two nursery firms in the state of New Jersey and one in Missouri. He detailed in full the remedial work which has been undertaken by the Division of Entomology of the United States Department of Agriculture in each of the six eastern localities, and showed that by virtue of the active measures which have been taken, the insect will probably be stamped out in the east by the close of the season.

The next paper was on the same subject, and discussion was therefore deferred.

Mr. Smith then read a paper on the San Jose scale in New Jersey. He stated that the scale had first come to him from a nursery in the state in March, 1892, but had not been recognized and he did not become aware of the true nature of the insect until he received the special circular sent out by the United States Department of Agriculture early in 1894. He described his work in connection with the stamping out of the scale, and particularly the active and energetic steps taken by the owners of the infested nurseries, from which the scale had been exterminated on young stock. He reported sending out letters to all persons who had obtained stock from the nurseries in question, enclosing the circular from the Department of Agriculture referred to, and the examination of nearly 100 orchards in person. As a result of his observations and work, he felt confident that the scale would ultimately be completely stamped out. The introduction of the scale was shown to have been either in 1886 or 1887, on some plum stock claimed to be curculio-proof, obtained from the San Jose region in California. Other fruit trees imported from California were also shown to be very likely infested. He gave some facts in regard to the trees and varieties which are most liable to be infested, also some notes on remedies.

In the discussion of these two papers Dr. Lintner considered the possibility of the introduction of the scale on fruit from California and concluded that the likelihood of the scale, so introduced, obtaining a foothold, was very slight.

Mr. Marlatt thought there was danger in placing too much confidence in the work or the statements of nurserymen as to the completeness of the eradication of the scale, pointing out the great difficulty of thorough extermination and the ease with which a random scale here and there could be overlooked. Mr. Banks referred to the publication in a New York paper of occurrences of the scale in two or three localities in New York, accompanied with the report of the adoption of active measures to stamp it out in each instance.

AFTERNOON SESSION—AUGUST 15TH, 1894.

In continuation of the discussion of the morning session, Mr. Smith exhibited specimens of California pears, obtained in Brooklyn which were covered with the San Jose scale in all stages of development.

Mr. Lintner exhibited an apple coming from Ottawa, Canada, handed to him by Mr. Saunders, which was covered with the scales of *Mytilaspis pomorum*. (Fig. 51.)

Mr. Davis read a paper on mealy bugs and other lice. He gave a careful resume of the life history of the common mealy bug (*Dactylopius destructor*) with detailed descriptions of the different stages, also some notes on *D. longifilis*. He also described a coccus which he found on roots of clover, giving a general account of the habits and careful descriptions of the species. He also referred to *Eriococcus azaleæ* and other scale insects.

The paper was discussed by Messrs. Sirrine, Ashmead and Howard. Mr. Sirrine thought Mr. Davis's clover coccus was the same as the one found by Professor Forbes on white clover, and named by him *Coccus trifolii*, Mr. Ashmead coinciding in this view, and Mr. Howard stating that the *Eriococcus azaleæ* was certainly not an introduced species from Belgium, as suggested by the author, since the species is not known in Europe, and Professor Comstock has found it on wild plants near Ithaca, indicating that it is undoubtedly a native species. He said also that the two old species of Dactylopius referred to by the author had been shown by Berlese to be synonymous with European species, and that their life histories had been worked out by this author in great detail.

Mr. Marlatt read a paper on the Pear-tree Psylla in Maryland, in which he described the sudden occurrence of this northern pear pest in two orchards on the eastern shore of Maryland, in very destructive numbers. The introduction of the species was shown to have been upon nursery stock from infested regions in New York, and the author was confident that the injury, while excessively severe for the moment, would not be of long duration, judging from the past history of the insect. A brief review of the life history was given, with some notes on the natural enemies, notably a species of lace-wing fly, *rysopa oculata*, the larva of which feeds voraciously on all stages of the Psylla ; also rious species of lady-birds which are useful in a similar way. The life history of the e-wing fly was carefully worked out. Experiments with various insecticides on the gs on the Psylla were detailed, and general recommendations for remedial work were ven.

The paper was discussed by Messrs. Davis, Southwick, Lintner and others, both essrs. Southwick and Lintner reporting cases of sudden appearance of the Psylla, with bsequent equally sudden disappearance.

Mr. Smith deferred speaking until the reading of his own paper which included a ference to the same insect, in which he said that the conditions described by Mr. Marlatt ere identical with the conditioms obtaining in localities in New Jersey, and that the urce of the introduction was also the same.

Mr. Smith then read a paper entitled "Notes of the year in New Jersey," which was summary of the important insects brought to the attention of the entomologist during e present season. It contained references to occurrences of the Pear-tree Psylla, the ar Blister-mite, the Pear Midge, a new pear pest in a species of Agrilus, probably *xius*, the habits of this last insect being described at some length. The paper also conlered the use of protective coverings for the trunks of trees as a means against the rer, invasions of cutworms, the Periodical Cicada, some potato insects, onion maggots, e remarkable mortality of the clover-leaf weevil larvæ, and the potato-stalk borer, *ichobaris trinotatus*, which had been brought to his attention for the first time the esent year. The paper was discussed by most of the members present.

Mr. Davis also presented a communication covering notes on special economic insects the season in Michigan, referring particularly to the occurrence of *Diplotaxis Harperi* a strawberry pest, a dipteron raspberry girdler, *Adimonia clavicollis* as a cherry tree foliator, *Notoxus anchora*, as feeding on fruit of cherry.

In the discussion Mr. Hopkins stated that he had found the raspberry cane maggot scribed by Mr. Davis, in the Alleghany Mountains in 1892, but did not rear the adult.

In the absence of Mr. Chittenden his paper entitled "Supplementary Notes on the trawberry Weevil, its Habits and Remedies," was read by Mr. Southwick. The writer ted the occurrence of the strawberry Weevil, (*Anthonomus signatus*, Say) in more or ss injurious numbers in parts of Maryland, Virginia, Delaware, Pennsylvania, and New rsey in 1893 and 1894. Three new food plants were discovered, the red-bud (*Cercis anadensis*), the dewberry and raspberry and the life-cycle from egg to adult was found extend over a period of four weeks. The methods of oviposition and of severing stems ere described. A table showing by States the destructive appearances of the insects from 71 to date is given. Under the head of remedies, the necessity of clean culture is inted out, also the benefit that might be derived from early-blooming varieties of aminates, and of the red-bud tree as trap-crop. Kerosene emulsion and Paris green ere found by experiment to be of service, but the latter gave the better results. Direcons are given for the application of these insecticides, three or four sprayings being lvised, beginning two or three days before first bloom. The subject of covering beds is nsidered, and, in conclusion, the fruit-grower is urged not to trust entirely to staminate arieties.

Mr. Smith said he had anticipated damage from this insect the present season, but so r as he had observed, it did not manifest itself in New Jersey.

In view of the lateness of the hour, the following papers were read by title only :

"Notes on the Insects of Northern Idaho," by J. M. Aldrich, Moscow, Idaho. This aper included a few notes on the principal pests of the "Pan-handle" district of Idaho, here the farming land is at an elevation of 700 to 3,500 feet, with a corresponding change climate. The insects discussed were the Wheat Aphis, the Codling Moth, Bud Moth, oolly Aphis, Pear-leaf Blister-mite, and the San José scale, which latter the author ated was the most dreaded insect pest, and a considerable effort was being made to preent its spread to new localities.

"Insects of the Year," by F. M. Webster, Wooster, Ohio. Mr. Webster's paper had particular reference to the occurrence of the larvæ of *Fidia viticida*, Walsh, in vineyards, which was the important insect manifestation of the year in Ohio. It also covered the raspberry Agrilus, the strawberry Weevil, the pear tree Blister-beetle, joint worms, the Bean Leaf-beetle, and other garden and small fruit pests, such as the Grain Louse, Corn Bill-bug, and a Thrips, which is proving very destructive to onion crops. Other insects were also mentioned briefly.

"Notes from New Mexico," by T. D. A. Cockerell, Las Cruces, N.M. This paper covered numerous short notes on various insects observed in New Mexico, with a description of the climatic and other conditions characteristic of the more important natural districts of the State, and the bearing of these on the insect fauna.

"Some Experience with Mosquitoes," by Howard Evarts Weed, Agricultural College, Miss. This communication covered the result of certain experiments in the use of kerosene as a means of preventing the breeding of mosquitoes in water reservoirs on the college campus. The use of kerosene was very satisfactory, and resulted in a very marked subsidence of the mosquito trouble. The author also reports that kerosene is a very good preventive to apply to the hands or face in the case of mosquito outbreaks.

The report of the committee on nominations was presented by Mr. Lintner as follows:

President—J. B. Smith.

Vice-President—C. H. Fernald.

Secretary—C. L. Marlatt.

The report was unanimously adopted and the officers named duly elected. (By inadvertence no second vice-president was nominated or elected.) It was decided to follow the usual custom for the next meeting, and hold it on the two days preceding the meeting of the American Association for the Advancement of Science, and at the place decided upon for the next meeting of that Association. On motion, it was requested that the minutes be printed in full in "Insect Life."

After the reading and approval of the minutes of the entire session, Mr. Southwick moved that the thanks of the Association be tendered to the President and Secretary for the able and satisfactory manner in which they had discharged their respective duties. The resolution was adopted.

The Association was then declared adjourned by the President for one year.

PROFESSOR C. V. RILEY.

Every entomologist in North America will, we are confident, join with us in the expression of the deepest regret, that Professor C. V. Riley has felt compelled, owing to the impaired state of his health, to resign his position as Entomologist of the United States Department of Agriculture. The admirable work that Dr. Riley and his staff have accomplished, both in scientific and economic entomology, during the many years that he was Director of the Division, is so well and widely known that it is unnecessary to enter into any details here. There are few who possess, in so eminent a degree as Dr. Riley, scientific ability, accurate knowledge, painstaking industry, and acute powers of observation; these gifts and attainments have been abundantly manifested in the immense additions that he has made to the knowledge of insect life in all its various phases, and twould be a calamity indeed if they were withdrawn from active exercise. It is gratifying, then, to know that Dr. Riley will retain the honorary Curatorship of the Department of Insects in the United States National Museum at Washington, and that he will now devote himself to some long contemplated work of a purely scientific character. We earnestly trust that the relief from the cares and anxieties of administrative work in a Government office will speedily restore his health and strength, and that we shall see the fruits of his labors during many a year to come.

While we deplore Dr. Riley's resignation, we cannot refrain from expressing our gratification at the appointment of his successor. The authorities at Washington have shown their wisdom in conferring the vacant office upon Mr. L. O. Howard, who has been so long and so ably sharing in its duties as First Assistant. The Department is certainly to be congratulated upon having at hand a skilled and learned entomologist who possesses in every respect the varied qualifications necessary for the successful performance of so important an office. We have every confidence that the world-wide reputation now possessed by the Division of Entomology at Washington will be in no wise impaired under the administration of Mr. Howard, and we heartily wish him health, strength, and a long life for the successful performance of his arduous and important duties.—*C.J.S.B.*, *Canadian Entomologist*, June, 1894.

BOOK NOTICES.

THE BUTTERFLIES OF NORTH AMERICA: By W. H. Edwards. Third Series. Part XIII.

Another part of Mr. Edwards's magnificent work has been received, and is of particular interest to Canadian students. The three beautiful plates represent the following: Plate I., *Neominois Ridingsii*, Edw. The upper and lower sides of both sexes of the early and late forms are shown, together with the egg and pupa, and a full series of enlarged drawings illustrating the larva in all its stages. This is a Coloradan insect, and flies in the mountains at an elevation of from 5,000 to 8,000 feet. Up to the present there is no recorded instance of *N. Ridingsii* having been taken in Canada.

Plate II. shows *Chionobas Æno*, Bdl., male and female, and a variety of the male, as well as *Ch. Æno*, var. *Assimilis*, Butler, and the egg of *Crambis*, Freyer. *Æno* is an arctic species occurring with the variety in Labrador, and also in Colorado where it inhabits the loftiest mountain peaks. An interesting account of its habits is given from the notes of Mr. David Bruce, who has done a great deal to work up the life-histories of the butterflies of the Coloradan mountains. *Æno* belongs to the *Semidea* group of the genus, and has been confounded with that species and *Crambis*, Freyer. Mr. Edwards says: "It was not till Mr. Bruce explored the peaks of Colorado that it became possible to understand what *Æno* was, and the limitation of *Brucei* made clear the position of *Crambis*."

The series is now arranged as follows:

1. CRAMBIS, Freyer.
2. BRUCEI, Edw.
3. ÆNO, Bdl.

——— var. ASSIMILIS, Butler.

4. SEMIDEA.
5. SUBHYALINA.

Ch. Also, Bdl., Mr. Edwards rejects altogether as an American species.

Plate III. shows *Ch. Macounii*, the grand species which was discovered at Nepigon, north of Lake Superior, by Prof. John Macoun, of the Geological Survey, in whose honor it was named. *Ch. Macounii* belongs to a different group of the genus to the species mentioned above, and finds its place with *Californica* and some other large species occurring on the Pacific Coast. It is a fine insect expanding 2–2½ inches and has the remarkable feature of lacking the sexual band of androconia or special scales, which is such a striking characteristic of the males of all the other species in the genus. The plate is a very beautiful one, and shows a pale male and the full life-history with the exception of the pupa. The female figured, although of course copied from an actual specimen, is hardly typical of that sex, and it is to be hoped that at some future time Mr. Edward will publish another illustration showing the more usual form, which has a much riche appearance both on the upper and under sides.

Ch. Macounii is decidedly a variable species, both in the intensity of the golde brown of the wings, in the amount of infuscation along the nervures, and in the size an number of the ocelli. Both sexes frequently have three ocelli on the primaries, an occasionally four. One specimen in my collection, plainly a male, has four distinct ocell on the primaries, the second and fourth from the apex large and pupilled. In fact, thi specimen has more nearly the markings of what appears to me the typical form of the females There is also a very much infuscated variation of the male which is rarely taken, in which the nervures, are all broadly bordered and the greater part of the surface of the disk is covered with dark scales. One of these was mentioned by Mr. Edwards in his original description (*Can. Ent.*, XVII., p. 74), and was omitted from the plate now published fo want of space. The life-history of this species has not yet been worked out, as no on has succeeded in obtaining the pupa. It will probably be much like that of *Ch. Chryxus*, but for the present it is unknown, and it remains for some expert and patient breeder t carry the larvæ through all their stages and obtain this missing link. The eggs are easily obtained when a female has been captured ; but the breeding is very tedious, the larval life lasting nearly two years. J. F.

MONOGRAPH OF THE NORTH AMERICAN PROCTOTRYPIDÆ : By William H. Ashmead Bulletin of the U. S. National Museum, No. 45; pages 472; plates 18.

Every student of the Hymenoptera must be delighted at the issue of this magnificent volume, which bears most ample testimony to the extensive studies and patient industry of the author. Treating, as he does, of a family in which the American species had previously been but meagrely represented in collections, he has necessarily been compelled to describe a large proportion of the insects now recognized, and to erect a considerable number of genera for their reception. The labor involved in the critical examinations requisite for the determination and description of so many microscopic forms, and in the preparation of the voluminous text, must have been enormous, yet the author has been able to amplify and embellish his work by the delineation of some one hundred and fifty exquisite figures.

The position of the Proctotrypidæ in the order Hymenoptera is considered to be much more closely allied to some families of the Aculeata than to the Chalcididæ, with which they have been usually grouped, while they also approach in other respects the parasitic Cynipidæ. The Mymarinæ, hitherto included as a sub-family, are set aside as constituting a distinct family allied to the Chalcididæ, so that the species now contained in the Proctotrypidæ are characterized, and distinguished from the Chalcids, by the pronotum extending back to the tegulæ, and the ovipositor issuing from the tip of the abdomen. Ten sub-families are recognized, which contain about one hundred and thirty genera, represented by nearly six hundred species—a doubling of the genera and quadrupling of the species as enumerated in the catalogue of Hymenoptera issued a few years ago by Mr. Cresson. Many of the genera are known only by single species, but others contain numerous forms, the most extensive being Polygnotus (32), Proctotrypes (21), Prosacantha (27) and Telenomus (32). The synoptic tables requisite for the separation of the species in such genera, as well as the tables for the distinction of genera, etc., give evidence of great care and skill in their preparation and arrangement.

While many of the genera are apparently confined to the more southerly and westerly regions, the species in other groups have an extended range, which at times seems to be almost continental, as for instance *Proctotrypes californicus*, which has been taken at Ottawa. The members of this family have received but scanty attention in Canada, so that their distribution northward cannot be stated, but undoubtedly many interesting species could be found by a careful and patient collector in any locality. Provancher, in his Faune Entomologique, was able only to announce the occurrence of *nine* species, and about twice as many are recorded in his Additions completed just before his death. Mr. Ashmead, however, has been able to enlarge the list of Canadian species to about ninety. With the exception of three forms from Vancouver Island, the species are all from a few localities in eastern Ontario and Quebec, so that the Dominion as a whole has been practically unworked. The three western species are *Mesitius vancouverensis* and *Polymecus vancouverensis*, collected by the Rev. G. W. Taylor, of Victoria (and communicated through the writer to Mr. Ashmead), and *Anteon puncticeps*, taken by Mr. Wickham.

Although the Proctotrypids are all small, and frequently microscopic, they show great variations in structure, and their study thus becomes very interesting. A large proportion of them are egg-parasites, while others prey upon Aphididæ, Cecidomyidæ, etc. In many species (noticeably in the sub-family Bethylinæ) the females differ largely from the males in the shape of the head, antennæ and structure generally. Those of the sub-family Dryininæ have remarkable chelate, or pincer-like claws, on the anterior feet, which are probably for more firmly grasping, during oviposition, the small, active homopterous insects on which the larvæ are parasitic. Many forms are wingless or have very rudimentary wings, but they are, nevertheless, very nimble little atoms, and can leap many times their own length.

As the appearance of Mr. Ashmead's splendid monograph may stimulate some of our members to the collection and study of these insects, it may be stated that a considerable number of the species, such as Bæus, etc., may be obtained even in winter by sifting moss as it is done for small coleopetra. This habit of hibernating in the moss of swampy localities is another feature (not mentioned by the author) which separates them from the other hymenoptera known to me, with the exception, perhaps, of ants, which are also occasionally obtained in sifting. W. H. H.

THE BUTTERFLY HUNTERS IN THE CARIBBEES: By Dr. Eugene Murray-Aaron. New York; Charles Scribners' Sons, 1894; pp. 269.

It is a novel event in literature to have a boys' book of adventure written by an entomologist; we were, therefore, prepared to peruse with interest the volume which Dr. Murray-Aaron has just published. Belonging, perhaps, to those whom he characterizes as the "younger old people," we were charmed beyond measure with the book and read it through from beginning to end with as much avidity and enjoyment as any adventure-loving school-boy. It relates, in pleasant easy style, the expedition made by a couple of boys under the guidance of their naturalist friend "the doctor." During the early winter months they visited several of the islands of the Bahamas, and then made a more venturesome excursion across Haiti and into Santo Domingo, winding up with a flying visit to Jamaica. Their object was to collect butterflies especially, and at the same time to gather all the animal and vegetable curiosities that they conveniently could. For an account of their success and the various "dodges" they had recourse to, especially when in pursuit of *Papilio Homerus*, we must refer the reader to the book itself. It is not, however, a mere record of the doings of collectors; a great deal of interesting information is given regarding the condition of the negro races in their barbarism where left to themselves, and their happy condition when under British rule. Much pleasant instruction may also be gained regarding the geography, scenery and government of the various islands that were visited. If any paterfamilias is looking for a book to put in his boy's Christmas stocking, he cannot do better than purchase a copy of this; if his boy has any taste for natural history it will delight him beyond measure. The book is handsomely printed and bound, and illustrated with several well-executed plates. The entomologist may be disappointed at the absence of lists or names of species and pictures of butterflies, but the book is not meant for a scientific treatise, though its statements may be relied upon as strictly accurate, the author being well-known as the editor for a time of *Papilio*, and Curator of the American Entomological Society at Philadelphia, as well as a valued contributor to the *Canadian Entomologist*. C. J. S. B.

RANDOM RECOLLECTIONS OF WOODLAND, FEN AND HILL; AND WOODSIDE, BURNSIDE, HILLSIDE AND MARSH: By J. W. Tutt, Editor of the *Entomologists' Record and Journal of Variation*. London: Swan, Sonnenschein & Co.

The name of the author of these two volumes must be familiar to our readers as an occasional contributor to our pages, while he is widely known as a writer of much scientific repute on matters concerning the lepidoptera. In these two books he has assumed a lighter and more popular role; his aim has been—to quote his own words—"to bring under the notice of the general public, in readable and untechnical language, a few of the interesting phenomena which are to be observed everywhere around us by those who take the trouble to look for them, and to give such explanations of their causes as may easily be understood even by those whose scientific knowledge is small." He has certainly carried out his design most successfully and given to the world two very charming and interesting books on out-of-doors natural history. Any one, whether young or old, who takes any pleasure in the beauties of nature and any interest in the varied world of animal and vegetable life, will read them with the greatest delight and follow the author with unflagging interest during his rambles over hill and dale, and by marsh and burn and fen. In the former work more attention is paid to the habits and variations of insects, while the latter treats of any animal or plant that may be met with in expeditions to widely different localities. Amusing episodes and pretty bits of verse enliven the volumes, and many capital pictures render the later one still more attractive.

C. J. S. B.

REPORT OF THE ENTOMOLOGICAL DEPARTMENT OF THE NEW JERSEY AGRICULTURAL COLLEGE EXPERIMENT STATION: By John B. Smith, Sc.D., for the year 1893.

It is obviously impossible to notice all the ever-welcome bulletins and reports that constantly flow from the various experimental stations throughout North America, for copies of which we are very grateful to their authors. We may, however, call attention to Dr. Smith's excellent departure from the ordinary report. After giving the usual general review of the season, and an account of the most important insect attacks of the year, he devotes a large portion of his work to a most useful and admirable account of the "Beneficial Insects" in all the different orders. It is clearly and plainly written, so as to be within the comprehension of non-entomologists, and is profusely illustrated with excellent figures, many of them being new reproductions by means of photography. It ought to be widely distributed, in order to teach the general public that a very large proportion of insects are not noxious, and should not be wantonly destroyed. C. J. S. B.

REPORT OF THE ENTOMOLOGIST AND BOTANIST (JAMES FLETCHER, F.R.S.C., F.L.S.), Central Experimental Farm, Ottawa, 1894.

Mr. Fletcher's Reports are always interesting and valuable; and the present record of the chief insect attacks of last year, and his observations upon them, is not less so than its predecessors. The season of 1893, as far as destructive insects were concerned, was only remarkable for the superabundance of locusts (grasshoppers), and the consequent damage inflicted upon oats and many other field and garden crops. Other attacks were for the most part of the familiar kinds which we have always with us; these are briefly mentioned in the Report, while more attention is paid to the serious injury caused to grain crops in Manitoba and the North West by cut-worms, the ravages of locusts, granary insects at the Chicago Exhibition, the horn-fly, etc. Very interesting accounts are also given of *Silpha bituberosa*, which attacks vegetables in the North West Territories; and *Polyphylla decemlineata*, which was very injurious to shrubs of various kinds in a nursery at Victoria, B.C.

In the Botanical section of the Report there are two papers especially noteworthy: those, namely, on "Grass for the protection of shores and harbors," and on the "Tumbleweeds" of the North West. The pamphlet is illustrated by a handsome full page picture of Mr. Fletcher's grass plots at the Experimental Farm, which are full of interest to every visitor; and thirty wood-cuts. It is gratifying to observe how steadily the author's reputation is growing, and how highly his work has come to be appreciated from one end of the Dominion to the other. C. J. S. B.

EIGHTH REPORT OF THE INJURIOUS AND OTHER INSECTS OF THE STATE OF NEW-YORK FOR THE YEAR 1891 : By J. A. Lintner, Ph. D, State Entomologist, Albany, 1893.

Anything published by Dr. Lintner is sure to contain much valuable information and to be highly interesting, whether the subjects treated of are new to us or not. The Report before us fully supports this statement. It treats of a large number of insects, injurious or otherwise; and gives in most cases a life history of each, including the author's own observations, which are always accurate and clearly detailed. Attention may especially be drawn to the accounts of the Raspberry Geometer (*Synchlora glaucaria*), the Birch-leaf Bucculatrix (*B. Canadensisella*), and the Pear-midge (*Diplosis pyrivora*). An appendix contains some very interesting popular lectures on Economic Entomology, which are well worth perusal. The only drawback to the Report is the late date of its publication, which is more than two years after the observations recorded in it were made. C. J. S. B.

BUTTERFLIES FROM CHINA, JAPAN AND COREA : By John Henry Leech, B.A., F.L S., etc. In parts, 4-to, 642 pp , 43 plates ; R. H. Porter, London, Dec., 1892 —Jan., 1894.

The fifth and last part of the letter-press of Mr. Leech's work has just been issued, and is accompanied by the statement that five plates of Hesperidæ and a supplemental plate will shortly follow, completing the work. Presumably these plates will be accompanied by the letter-press of the title-page, preface and index, with which the work will be ready for the binder. As to the typography of the book, it must be said that it leaves nothing to be desired. The paper is luxuriously heavy ; the type is beautifully clear and large ; and the text conspicuously free from errors of a minor character, such as occasionally appear even in the most carefully edited works. The scholarship and taste of Mr. Leech and his accomplished secretary, Mr. Richard South, are reflected in the execution of the literary portions of the work. The plates, which are from drawings by William Purkiss, and are executed by chromo-lithography by William Greve, of Berlin, are without doubt the finest examples of this form of work which have as yet graced any similar publication. While a preference is by many accorded to figures lithographed and afterwards colored by hand, and the most exquisitely perfect illustrations have been produced in this way; and while the results of chromo-lithography as ordinarily employed in scientific illustrations have generally been more or less marred by striking crudities, these plates before us are most marvellous illustrations of the capabilities of the chromo-lithographic process, when employed by those who are masters of the art. The plates are almost perfect facsimiles in form and color of Mr. Purkiss's exquisite drawings ; and the student of Chinese and Japanese lepidoptera may well rejoice upon having at his command such an infallible guide to specific identity as is found in these beautiful illustrations. The only adverse criticism which the mechanical and typographical execution of the work admits is on the score of the bulk of the letter press, which will necessarily be bound up in one volume. The heavy paper employed results in the production of a book which, as a manual of reference, promises to be somewhat uncomfortably " fat."

The title of the book indicates the consciousness of the author that, in our present state of knowledge, any effort to deal with the lepidopterous fauna of the great regions covered by this work must at best be attended by imperfections. There are wide areas in China in which little or no attempt has yet been made to make collections ; and it must necessarily be many years before it can be asserted that our knowledge of the faunistic resources of Central Asia is complete. In his classification, Mr. Leech follows the order now almost universally recognized by writers in England and on the continent as most natural. He erects, as far as the writer has been able to observe, no new genera ; and while giving us a large number of new species, appears to have pursued a conservative course in this regard, which is to be commended. To the student of Asiatic lepidoptera the work is simple indispensable, and will remain a lasting monument of the energy and scientific accomplishments of its learned and enthusiastic author. W. J. HOLLAND.

MISCELLANEOUS ENTOMOLOGICAL PAPERS, BY F. M. WEBSTER, FEB. 1894.

We have just received a neat pamphlet of 59 pages, which forms Bulletin 51 of the Ohio Agricultural Experiment Station. It is by Prof. F. M. Webster and like all his work shows careful preparation.

The insects treated of in the first part are: The asparagus beetle, the western corn root worm, the broad striped flea beetle, blister beetles, the basket worm, the cabbage aphis and the apple leaf louse.

An interesting account of the insects which have been introduced into the State is given under the head of "Some insect immigrants in Ohio." There appears to have been two great highways which insects imported from Europe have followed: those which have entered the State at its northeastern corner and spread westward, and those from Southern Europe which have generally entered by way of the Ohio Valley and have a more or less restricted northern distribution.

In the article "Insect foes of American Cereals" the writer is evidently dealing with a subject of which he has made a special study. By patient observation and the application of practical common sense, Prof. Webster has made some important discoveries in Economic Entomology. Not the least of these is the fact recorded in this pamphlet that the apple aphis passes part of the year as an injurious enemy on wheat. Infact Mr.Webster says: "So far as my own observations go, it is more detrimental to the wheat than to the apple." This is an important discovery and will doubtless draw the attention of entomologists to this important subject of the "Alternation of Generations" among the aphides —a line of investigation which has engaged much of the time of Messrs. Riley and Howard at Washington. Speaking of remedies, Prof. Webster says: "It would appear almost visionary to advocate spraying apple orchards with kerosene emulsion in mid-winter to protect the wheat crop, but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the apple during the winter season. I refer to the apple leaf louse, (*Aphis mali*, Fab.")

"Soon after the young wheat plants appear in the fall the winged viviparous females of this species flock to the fields, and on these give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from young plants . . . . though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the aphis abandons them in autumn to return to the apple, do they show any amount of vigor. It is very seldom that the affected plants fully recover, at least in autumn; and the result must be to reduce their productiveness the following year." The eggs of the apple leaf aphis are deposited on the twigs and limbs of apple trees late in the autumn; these do not hatch until the following spring; the plant lice remain on the apple trees for two or three generations, when winged females are produced, which fly to grasses and weeds and there pass the summer. After the young wheat is up in the autumn, the lice congregate on the plants and reproduce rapidly.

The above is briefly the life history of this insect in Ohio as worked out by Prof. Webster by careful experiments which are detailed in the Bulletin. At Ottawa this probably may also, to a large extent, be the case; but the aphis is also sometimes abundant on young apple trees right through the season. It is, however, seldom injuriously abundant in Ontario, although in British Columbia it is to-day one of the most serious enemies of the apple grower.

Prof. Webster's paper will doubtless cause many other entomologists to study this insect more closely, when it is probable that further discoveries will be made, perhaps not less interesting than that now discussed.

J. F.

THE INTER-RELATION OF INSECTS AND FLOWERS.

During the last 8 years there have appeared from the pen of Mr. Charles Robertson, of Carlinville, Ill., several most interesting articles on the inter-relation of insects and flowers. The titles are as follows:

Botanical Gazette—

1886. Notes the on pollination of Asclepias.
1887. Insect relations of certain Asclepiads.
1887. Fertilization of Calopogon parviflorus.
1888. Effect of the wind on bees and flowers.
1888. Zygomorphy and its causes: I-III.
1889-93. Flowers and Insects: I-XI.

Trans. Am. Ent. Soc.—

1889. Synopsis of North American species of Oxybelus.
1891-93. Descriptions of new species of North American Bees.

Trans. St. Louis Acad. of Science—

1891-92. Flowers and Insects: Asclepiadaceæ to Scrofulariaceæ, Umbelliferæ, Labiatæ.

Mr. Robertson began in 1886 to study the visits of insects to flowers and by his persevering observations he has succeeded in collecting an enormous number of facts which he has published mostly in the *Botanical Gazette* and in the Transactions of the St. Louis Academy of Science.

He has studied the subject especially from a botanical point of view and has given particular attention to the attractions offered to insects by the flowers of different species of plants, to the peculiarities of arrangement of their different parts, to their coloration, and to the modifications which many flowers seem to have undergone from their being constantly frequented by certain species of insects.

Such studies have nevertheless an immediate bearing on entomology, as they give us at the same time an insight into the purposes of insects in visiting flowers, into their habits of feeding and collecting either nectar or pollen, or both at once, and into the intelligence they display in order to attain their end. The close attention thus necessarily given to insects, has had besides the natural result of causing Mr. Robertson to discover that many of those insects which he was observing in his locality, Carlinville, Ill., had not even been described. Therefore, he found it necessary at first to pay particular attention to collecting and determining insects. He was helped in this work by specialists in Diptera and Coleoptera, and had himself to work out and describe many species of Hymenoptera: 10 out of 14 species of *Oxybelus*, 28 out of 30 of *Andrena* and at least thirty other species of Andrenidæ. The descriptions of these have appeared in the Trans. Am. Ent. Soc., 1889-1893.

The two great agencies of cross-fertilization of flowers are the wind and insects; hence Mr. Robertson has thus been led to notice some interesting facts concerning the effect of wind on bees and flowers.—*Bot. Gaz.*, xiii., 1888, p. 33.

The first papers by Mr. Robertson are on the pollination of Ascelepias, the flowers of which are most interesting in their peculiar adaptation for cross-fertilization by the agency of insects. Their structure and the great difficulty the smaller insects have in effecting pollinations, leads Mr. Robertson to believe, "that bumble-bees have had most influence in modifying the flowers, and they are the most common visitors after the hive bees. Hive bees, it is to be remembered, do not belong to our fauna."

Our space is too limited to allow us to follow the writer into what he has observed in all the different orders and species of flowering plants studied; but the names of all the insects observed visiting the flowers, are given, as well as tabular data of the respective number of visitors of the different classes, Hymenoptera, Diptera, Lepidoptera, Coleoptera and Hemiptera. As an instance, it may be mentioned that on the flowers of *Ceanothus Americana* there were seen forty-eight species of Hymenoptera, forty five of Diptera, two of Lepidoptera, thirteen of Coleoptera, and four of Hemiptera ; and considerations are given as in the case of all other blossoms treated of, on the arrangement of the flowers, their form, color and other peculiarities of structure, some of them exceedingly minute, in which close and patient observation often succeeds in discovering most wonderful purpose and design for insuring cross-fertilization.

These investigations are of great interest and we commend them to the attention of entomologists and botanists as a fertile field of useful special study. Our idea of mentioning these excellent articles of Mr. Robertson's is to draw to this subject the attention it deserves from entomologists, who from their place of publication might not be aware of their existence.

J. A. GUIGNARD and J. FLETCHER.

A PEN SKETCH OF PROF. WILLIAM SAUNDERS, F.R.S.C., F.L.S., ETC.*

By F. W. GODING, M.D., Ph.D., Rutland, Illinois.

A sketch of the life of Wm. Saunders is peculiarly instructive to young men, because of the fact that he has accomplished so much with so few opportunities in the way of a liberal education, having left school at the age of fourteen ; but by painstaking study and observation he has risen to the topmost pinacle of fame as an entomologist, horticulturist and experimental agriculturist. He was born in Crediton, Devonshire, England June 16, 1836. At the age of twelve with his parents he removed to Canada, and two years later was apprenticed to a chemist. After learning the art he engaged in business, continuing it in London, Ont., until his recent promotion in 1886 to the Directorship of the Dominion Experimental Farms. A sa chemist and pharmacist he is well known throughout the United States and Canada, his published papers being widely copied and translated into several foreign languages. He was President of the American Pharmaceutical Association in 1877-8, while in 1874 he was elected an honorary member of the Pharmaceutical Council of Great Britain. The Canadian Government recognizing his special qualifications appointed him Public Analyst, in which capacity he did good service in detecting and exposing adulterations, especially in articles of food. He was for a number of years, preceeding his recent promotion, Professor of Materia Medica in the Medical Department of Western University in London, Ont., a position he was peculiarly qualified to fill.

Coupled with all these attainments he has others in which we are far more deeply interested. As an entomologist and horticulturist he is known to every student of either branch, and to mention all the things accomplished by him in these departments would require far more space than is allotted to this paper. He began the study of botany some thirty-five years ago, publishing the first list of plants found in Western Ontario, embracing 545 species, in 1863. Some time prior to this he captured a fine specimen of *Papilio turnus* (in 1859 or 60) and found it possessed of so many beauties that he was led to look for others. From this chance occurrence he was directed to the study of insects in general, and as an entomologist is considered second to none in point of eminence. At the time of the organization of this society, in 1863, he took an active part, and much of its present flourishing condition is due to his careful management as President, a position he occupied during the greater part of its existence. While editor of the *Canadian Entomologist*, the only entomological magazine ever published in America that has been able to live to attain its majority, he was also one of its principal contributors, his articles published therein and in your society reports reaching many hundreds. The crowning work of his pen, however, is his "Fruit Insects," a magnificent volume of 436 pages, which has reached the second edition. The book has been received all over the world as the most valuable work of the kind ever published. One reviewer says of the book:

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*This account of the life of Prof. Saunders, whose portrait is prefixed to this Report, was written two or three years ago, and will be read with interest as conveying the impressions of a foreigner, who cannot be charged with the partiality of intimate friendship.—ED.

"We do not think that we are speaking too highly in praise of the work—though we admit it is saying a great deal—when we express our opinion that Mr. Saunders's volume will take rank with that standard of excellence, Harris's injurious insects of Mass., and that he has done for insects affecting fruits at the present day what his justly famed predecessor accomplished long ago for those injurious to vegetation in general."

It appears that the work was just what was wanted from the immense sale of it, about 2,500 copies having been sold. This seems all the more strange when it is stated that the average circulation of entomological works rarely exceeds two or three hundred copies.

Since 1867 he has been a director of the Fruit Growers' Association of Ontario, and its president since 1882. In his experimental grounds he has tested a great variety of fruits, laboring constantly to ascertain which are best adapted to the climate of Canada. In this manner he has, by experiments in cross-fertilization, obtained several good raspberries, gooseberries and grapes. His interest in horticulture and forestry has prompted him to become familiar with these important departments and caused him to awake general interest in these matters in the province in which he lives.

A special commission was appointed by the Government of Ontario, in 1880, to inquire into the progress and condition of agriculture in the Province. As one of the commissioners, Mr. Saunders was charged with the special duty of inquiring into the subjects of fruit growing and forestry, insects and insectivorous birds, and bee-keeping. In his report, published in a large 8vo volume of over 850 pages, he treats each of these subjects as one familiar with them, leaving no topic to be hereafter completed.

As a result of this careful inquiry into the agricultural condition of the Province, the Government caused to be purchased large tracts of land located in the various Provinces, to be known as the Experimental Farms, which were fitted up with all modern appliances and buildings, properly stocked, and then placed Prof. Saunders in charge as Director. Probably nowhere in the Dominion could be found a man so well qualified, by education, tastes and executive ability, as he, to be placed in this responsible position. Already this institution has taken a front rank among similar ones and under Prof. Saunders's charge is destined to become second to none.

Prof. Saunders's services have been recognized in various ways. Some years ago he received from the Duke of Mantua and Montserrat a handsome gold medal in acknowledgment of valuable services in the interests of natural science. He is Fellow of A.A. A.S.; of Linnean Society of London, and of Royal Microscopical Society of London, England; one of the twenty original members of the Royal Society of Canada; Corresponding Member of American Entomological Society; Natural History Society of Montreal; Buffalo Society of Natural Science, etc., etc.

He was married August 1st, 1857, to Sarah Agnes, daughter of Rev. J. H. Robinson, of London, Ontario. They have six children, one daughter and five sons. Several of the latter have inherited the tastes of their honored sire, and are working their way into public favor.

Prof. Saunders is five feet ten inches in height, with a symmetrical figure, and weighs about 175 pounds. His hair is dark brown, his eyes blue. He is one of the most approachable of men, with a look of kindness ever beaming from his genial countenance, yet with a quiet dignity which forbids familiarity.

And now our pleasant task is done. Prof. Saunders at last has found a sphere in which his broadly developed abilities have ample space in which to labor. And here we leave him with the agricultural eyes of Canada ever upon him, awaiting developments that are sure to come and wholly for their interests.

OBITUARY.

THE LATE DR. HAGEN.

Hermann August Hagen was born May 30, 1817, at Konigsberg, in Prussia. His parents were Carl Heinrich Hagen, Professor of Political Economy, Technology and Agriculture at the University of Konigsberg, and Anna Dorothea Linch. His first instruction was received at the gymnasium "Collegium Friedericianum," whence he was transferred in 1830 to the "Kneiphofische Gymnasium." He graduated in 1836, studied medicine at the University of Konigsberg and received the degree of Doctor of Medicine in 1840. After the death of his grandfather, Carl Gottfried Hagen, Professor of Natural History in Konigsberg, the latter's entomological collection and library came into the possession of the grandson. Under his father's direction he studied entomology in his leisure time, collecting chiefly Odonata, because by chance the first specimen he caught proved to be an undescribed insect of that order. While he became gradually more interested in this particular study, he had the benefit of some instruction from two eminent and still active naturalists, Theodor von Siebold and Carl Ernst von Baer, who called his attention to the necessity of the study of medicine for the naturalist, the knowledge of pathology being indispensable to a comprehension of any normally constituted organism. He attended also for several years the lectures of Professor Rathke, the celebrated embryologist, and accompanied him in 1839 on his scientific journey through Norway, Sweden and Denmark, studying chiefly the anatomy and habits of marine animals. In 1840, he published at Konigsberg, as a dissertation for the degree of Doctor of Medicine, a little work entitled "Synonymia Libellulinarium Europæorum." From 1840-1 he studied at the University of Berlin and passed, according to the law of Prussia, the necessary examinations as physician and surgeon. He then travelled through the greater part of Europe. In Vienna he attended clinical and medical lectures for six months, and in Paris for nearly a year. The study of natural history was in the meantime always pursued, so far as time and circumstances allowed, and his acquaintance with Baron de Selys-Longchamps, of Liege, made in Paris, 1842, gave rise to a series of entomological publications containing their combined studies of the family of the Odonata. He was favored at this time with the counsel and encouragement of the prominent entomologists, Klug, Erichson, Kollar, Von Siebold, and many others whose personal acquaintance he had made during his travels. He returned to Konigsberg in 1843, and settled there as a practising physician. For three years he was first assistant at the surgical hospital, performing the greater part of the operations. In 1851 he was married to Johanna Maria Elise Gerhards. His duties as a physician limiting his studies in natural history to leisure hours, he confined himself to entomology (with especial reference to the Neuroptera), entomological biology, and the study of the microscope. The fear of wasting time in investigating subjects which had already been elucidated induced him to catalogue carefully all accessible entomological publications. This compilation, begun for his own use, was afterwards published as "Bibliotheca Entomologica," in two volumes, Leipzig, 1862. Alone, or jointly with Baron de Selys-Longchamps, he has published in various scientific periodicals a large number of notes, papers and monographs, all of which, up to 1861, are mentioned in his "Bibliotheca." His first publication was made in 1834, on "Prussian Odonata." It was his wish to prepare monographs in all families belonging to the Linnæan Neuroptera, but circumstances did not permit the full execution of this plan. In 1849, 1857 and 1861 he made extended scientific journeys through Germany, Belgium, Holland and England for the sake of comparing collections and libraries. From 1863 67, his official duties as Vice-President of the City Council and Member of the School Board of the City of Konigsberg left him no leisure. A large number of reports on a great variety of subjects relating to these duties demanded much careful study. Some of them, as for instance one on "Life Insurance," are exceedingly elaborate treatises. In 1863 he received the honorary degree of Doctor of Philosophy from the University of Konigsberg.

He was corresponding or honorary member of a large number of learned societies. In 1867 Professor Agassiz invited him to come to Cambridge as assistant in entomology, and in 1870 he was appointed Professor of Entomology in Harvard University.*

"Dr. Hagen entered upon his duties at the Museum with great zeal; and his detailed plan for the arrangement of the collections, though somewhat modified, is, and is likely to remain, the basis for the future. Deeply interested in everything relating to museum work, as his appreciation of series of specimens, his care for their preservation and for the accuracy of their localities, and many minor details, clearly indicate, it is in this collection as well as in his writings that his contributions to science are to be found. Here alone we can fully realize the extent of his discoveries, the keenness of his insight, his skill at preparation and dissection, and with the pencil. His devotion to the Museum knew no bounds; all personal interests were secondary. In 1876 he refused a most flattering and urgent invitation to take charge of the great entomological collections of the Konigliches Museum für Naturkunde in Berlin, and the time that might have been given to original work was lavished upon the care and arrangement of the collections, which grew rapidly both in size and value. The biological collection, or that illustrating the life-history of the species, is a prominent specialty of the Cambridge Museum. In this are preserved specimens showing every condition of an insect's life, the eggs, larvæ in all stages, from those just hatched to those full-grown, their burrows, nests, partially devoured leaves, etc., the work of both larvæ and adults, the frass or excrements often of great importance, pupal stages, adults of both sexes, and the parasitic and predaceous enemies, also in all stages of development. Dr. Hagen's influence upon the formation of such biological collections has been very great; few were in existence at the time when, almost unaided, he created that at Cambridge, and the care and elaborateness with which the whole is labelled makes it not only a worthy model, but most truly a monument to persistent and well-directed industry.

"His lectures, given at rare intervals to advanced students, contained much genuine and exact knowledge, and his many acts of kindness and words of wise counsel will not soon be forgotten by those who enjoyed the facilities of the Department under his charge.

"Most of Dr. Hagen's journeys were undertaken for study among collections and in libraries. In the summer of 1882, however, accepting the generous and thoughtful invitation of Professor Raphael Pumpelly, at that time Director of the Northern Transcontinental Survey, he visited California, Oregon, Washington and Montana. The object of the survey was to collect data concerning insects injurious to vegetation, both of the field and of the forest. The greater part of the time was spent in the Yokima and Columbia regions of Washington; many important entomological discoveries were made, some with a direct economic bearing, and large collections of insects were obtained from a most interesting locality.

"Dr. Hagen was a man of marked character, simple and sympathetic, and if at times somewhat hot and hasty in temper and impatient of opposition, he had also one of the warmest of hearts and most generous of dispositions. His unostentatious hospitality was enjoyed by many entomologists, who found his life in Cambridge quiet, contented and happy.

"Of Dr. Hagen's domestic life it is sufficient to record here that in 1851 he married Johanna Maria Elise Gerhards, who survives him.

"Dr. Hagen received the honorary degree of Doctor of Philosophy from the University of Konigsberg in 1863. Harvard made him a Doctor of Science in 1887. The renewal of his medical degree on the 17th of October, 1890, the date of his graduation fifty years previously, after the custom of German Universities, gave him great pleasure. He was elected a fellow of the American Academy of Arts and Sciences, November 11, 1868, and served on the Council in 1877-78. He was also a member of a goodly number of scientific associations and most of the entomological societies the world over were glad to enroll him as an honorary member.

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* From "Biographies" following Thomas S. Cary's sketch, "The Museum of Comparative Zoology," in The Harvard Book, by F. O. Vaille and H. A. Clark. Cambridge, 1875, Vol. I., p. 345-346, with portrait.

"Stricken with paralysis in September, 1890, Dr. Hagen lingered for more than three years; his painful sufferings being lightened by all that affectionate and devoted care could do. He died at Cambridge, Mass., November 9, 1893, and was buried in the grounds of Harvard University, at Mount Auburn, near his associate, Louis Francois de Pourtalès." (Samuel Henshaw, in the Proceedings of the American Academy of Arts and Sciences, Vol. xxix., 1894.)

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TWENTY-SIXTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1895.

PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO.

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY.

UNIVERSITY

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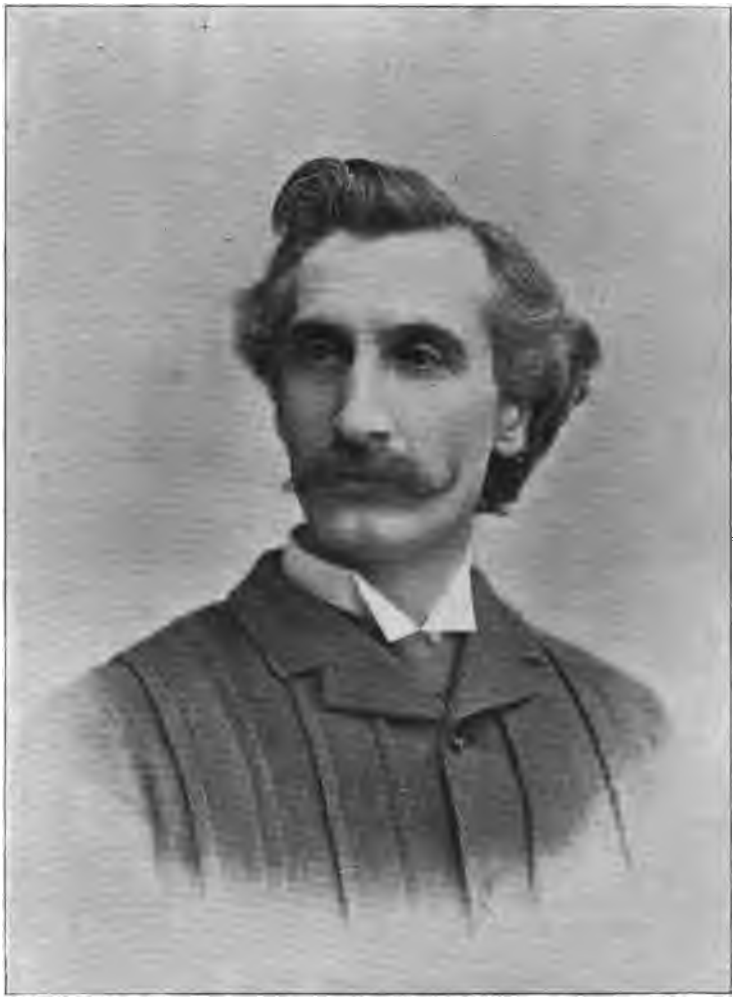
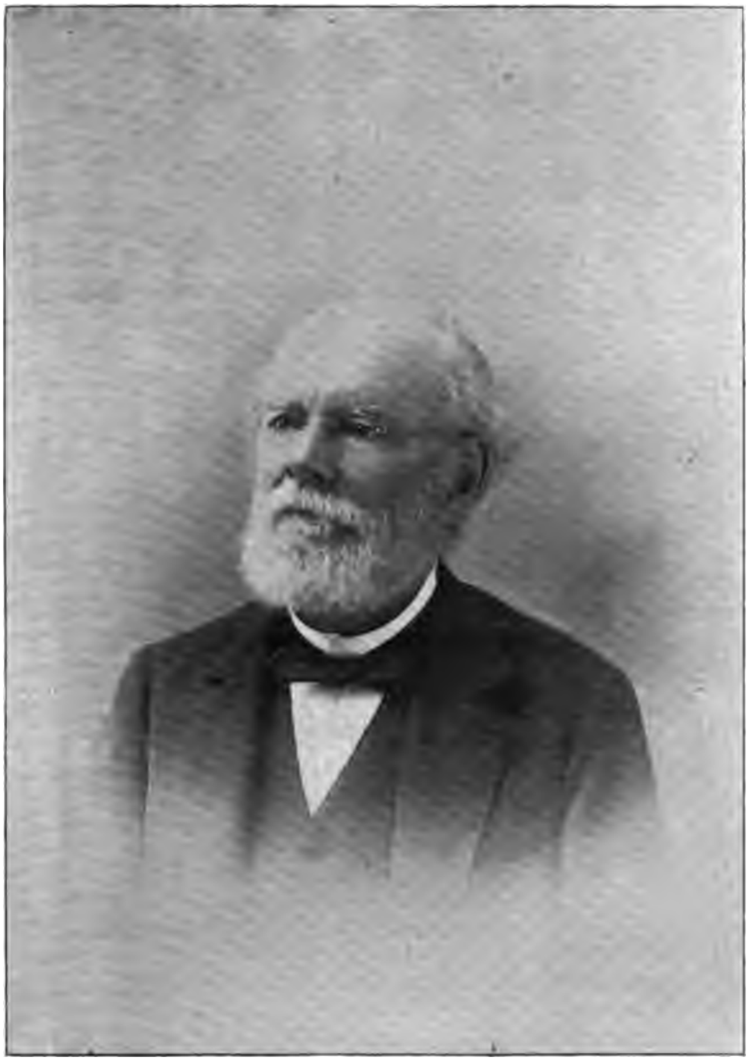


PROF. C. V. RILEY, M.A., Ph. D.



WILLIAM H. EDWARDS,
HONORARY MEMBER OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, ETC.

TWENTY-SIXTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO,

1895.

To the Honorable the Minister of Agriculture :

SIR,—In accordance with the provisions of our Act of Incorporation, I beg to submit herewith the Twenty-Sixth Annual Report of the Entomological Society of Ontario.

The report contains an account of the proceedings at our annual meeting, which was held in the city of London on the 27th and 28th of November last, for the election of officers and the transaction of the general business of the Society. A full report is given of the addresses delivered and papers read during the sessions, as well as the financial statement of the Treasurer and the reports of the sections and other departments of the Society.

The Canadian Entomologist, the monthly magazine issued by the Society, has been regularly published and has now completed its twenty-seventh volume, which in value and interest fully maintains the high reputation which it has so long held.

I have the honor to be, Sir,
Your obedient servant,

W. E. SAUNDERS,
Secretary.

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Your obedient servant,

W. E. SAUNDERS,
Secretary.

OFFICERS FOR 1896.

President	J. W. Dearness	London.
Vice-President	H. H. Lyman	Montreal.
Secretary	W. E. Saunders	do
Treasurer	J. A. Balkwill	do
Directors :		
Division No. 1	James Fletcher	Ottawa.
" 2	Rev. C. J. S. Bethune	Port Hope.
" 3	Gamble Geddes	Toronto.
" 4	A. H. Kilman	Ridgeway.
" 5	R. W. Rennie	London.
Librarian and Curator	J. A. Moffat	do
Auditors	J. H. Bowman J. M. Denton	do do
Editor of the "Canadian Entomologist"	Rev. C. J. S. Bethune	Port Hope.
Editing Committee	J. Fletcher H. H. Lyman Rev. T. W. Fyles J. M. Denton	Ottawa. Montreal. S. Quebec. London.
Delegate to the Royal Society	J. D. Evans	Trenton.
Committee on Field Days	Dr. Woolverton, Messrs. Sherwood, McClement, Balkwill, Saunders, Anderson, Rennie, Bowman, Elliott, and Stevenson	London.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY

1895

The thirty-third annual meeting of the Entomological Society of Ontario was held in its rooms in Victoria Hall, London, on Wednesday and Thursday, November 27th and 28th, 1895. In the absence of the President, the chair was taken by the Vice-President, Mr. J. W. Dearness, of London.

The meeting was called to order at four o'clock p.m., on Wednesday, the following members being present: Rev. C. J. S. Bethune, Port Hope; Mr. J. D. Evans, Trenton; Mr. James Fletcher, Ottawa; Mr. H. H. Lyman, Montreal; Rev. T. W. Fyles, South Quebec; Messrs. J. A. Balkwill, J. M. Denton, E. R. Cameron, J. A. Moffat, W. E. Saunders, R. W. Rennie, W. T. McClement and others, of London. A letter of apology was read from Mr. W. H. Harrington, of Ottawa, President of the Society, and a telegram from Capt. Gamble Geddes, of Toronto, regretting their inability to attend the meeting.

Mr. J. A. Moffat, the Librarian and Curator, presented and read his annual report, as follows:

REPORT OF THE LIBRARIAN AND CURATOR

FOR THE YEAR ENDING 31ST OF AUGUST, 1895.

The number of volumes added to the library by gift and purchase during the year was twenty-two. Ten volumes were sent to the binder, but some delay occurred in their return, which prevented their being entered within the year. I considered it desirable to include them in this statement, and in doing so, I had to include several others previously entered, which bring the number added to date up to thirty-eight.

The whole number on the register is 1,399.

The number of volumes issued to local members was thirty-three.

Mr. Fletcher has generously contributed to the library six volumes of the proceedings of the American Association for the Advancement of Science.

Many interesting additions have been made to the Society's collection of native lepidoptera during the year; principally by Mr. C. G. Anderson, one of our local members.

The specimens of *Nemeophila petrosa* received from Mr. Bean of Laggan, have been given a drawer to themselves, arranged in order as upon the plate, with the original numbers attached. The portions of Mr. Bean's paper descriptive of the individual specimens have been placed with them.

Mr. Rennie obtained by exchange cocoons of *Platysamia ceonothi*, and *Antheræa mylitta*, "the India Tussah silk moth," which he kindly shared with the Society. These matured and gave forth their imagoes, which have been placed with the exotic collection.

Respectfully submitted,

J. ALSTON MOFFAT,
Librarian and Curator.

The Treasurer, Mr. J. A. Balkwill, presented the annual statement of the finances of the Society, as follows:

REPORT OF THE TREASURER.

RECEIPTS.

Balance on hand Sept. 1st, 1894	$ 360 60
Members' fees	309 39
Sales of Entomologist	88 56
" pins, cork, etc	66 61
Government grant	1,000 00
Advertisements	21 40
Interest	9 47
	$1,856 03

EXPENDITURE.

Printing	$ 644 33
Report and meeting expenses	216 00
Library	47 38
Expense, postage, etc	117 02
Rent and fuel	102 70
Insurance	28 00
Salaries	300 00
Pins, cork, etc	58 69
Balance on hand, August 31st, 1895	341 91
	$1,856 03

We hereby certify that we have examined the books of the Treasurer and compared them with the vouchers, and find them correct and that the above is a correct statement.

JOHN M. DENTON, } Auditors.
JAS. H. BOWMAN, }

The Treasurer explained the various items of receipts and expenditure and stated that it would require the closest economy to carry on the work of the Society during the remainder of the year. Dr. Bethune and Mr. Fletcher spoke in commendation of the valuable services of Mr. Balkwill and of the high appreciation in which they were held by the members of the Society.

Mr. W. E. Saunders gave an account of the proceedings of the local members of the council with regard to obtaining more suitable and commodious rooms for the Society. After a long discussion, which was participated in by most of the members present, it was resolved that the matter be left in the hands of the local members of the council, who were authorized to take whatever action seemed to them most desirable for the welfare of the Society.

An application from the Senate of the Western University of Ontario was read requesting that their students in geology should be permitted to attend, free of charge, the meetings of the geological section of the Society. After some consideration it was resolved that the matter should be left in the hands of Dr. Woolverton, who is to deliver the lectures, and that he should have the liberty, which is shared by all the members, of introducing friends to the meetings of the section.

The following report of the council was next read and adopted:

REPORT OF THE COUNCIL.

The council of the Entomological Society of Ontario have much pleasure in presenting the following report of their proceedings during the past year:

They have much satisfaction in stating that the membership of the Society in London, and in the Province of Ontario generally, has largely increased, and that additions have also been made to our numbers in other parts of the Dominion, especially in British Columbia. The list of subscribers in the United States and Europe has continued about the same. The total number of names on our books is now considerably larger than ever before since the formation of the Society, while the interest in its work has by no means diminished.

The twenty-fifth annual report on Economic and general Entomology was presented to the Minister of Agriculture for Ontario in November last, and was printed and distributed at the beginning of January. It contained one hundred and twenty-six pages, a larger number than hitherto, and was illustrated with no less than sixty wood cuts, and two full page portraits, one of Prof. William Saunders, one of the founders and for many years President of the Society and editor of *The Canadian Entomologist*, and the other of Mr. A. R. Grote, of Hildesheim, Germany, one of our honorary members and a constant contributor to our publications. In addition to an account of the proceedings at the annual meeting, the volume contains the annual address of Mr. Harrington, the President, and the following interesting and important papers: "Insects collected in Bermuda," by Capt. Geddes; "Common names for Butterflies—Shall we have them?" by Mr. Lyman; "The Butterflies of the Eastern Provinces of Canada," by Dr. Bethune; "The Pitcher-plant Moth," The Gypsy Moth," "The San Jose Scale," and "Injurious Insects of the year 1894," by Mr. Fletcher; "Foods, Feeders and Fed," by Mr. Fyles; "The economic value of Parasitism," by Mr. F. M. Webster; "The structure of the undeveloped wings of the Saturniadæ" and "A reappearance of Pieris protodice," by Mr. Moffat; also a report of the sixth annual meeting of the Association of Economic Entomologists together with a few of the most interesting papers.

The Canadian Entomologist, the monthly magazine published by the Society, completed its twenty-sixth volume in December last. The numbers of the twenty-seventh volume have been regularly issued at the beginning of each month during the current year; the closing number for December is now in type and will be distributed next week. The volume when completed will consist of about 360 pages, and is illustrated by no less than six full page plates and twenty-three wood cuts Among the contributors to its pages are most of the leading Entomologists in North America as well as several in Europe. It is now the oldest monthly publication on insects published in America, and continues to maintain the high reputation that it has so long enjoyed.

A noteworthy event in the history of the Society is the republication, through the kindness of the Minister of Agriculture for Ontario, of the first annual report of our Society, which was prepared by Messrs. Bethune, Saunders and Reed in the year 1870, and published early in 1871. It contains articles on the insects injurious to the apple, grape and plum, and has been for some time out of print. Nothwithstanding that almost a quarter of a century has gone by since it was first issued, the volume is still in demand for public libraries and private collections.

The cabinets of the Society have been carefully looked after by the Curator, Mr. J. Alston Moffat, during the past year, and many valuable additions have been made. The collections owe many of these additions to the zealous work of Mr. C. G. Anderson, who has devoted much time and energy to the lepidoptera in the neighborhood of London. Mr. Bean, of Laggan, has presented a set of the specimens of *Nemeophila petrosa* which were illustrated in the April number of *The Canadian Entomologist*. Mr. Rennie has presented specimens of some interesting silk moths, of which he had obtained the cocoons; and Mr. Rowland Hill a beautiful case of Australian insects.

Mr. E. Firmstone Heath, of Cartwright, Manitoba, has sent through Mr. Fletcher, some interesting and rare lepidoptera captured in his own neighborhood; and Mr. Green, of Osoyoos, British Columbia, has also sent some very valuable and typical representative specimens of butterflies from the Okanagan valley.

The library is steadily growing and now numbers 1,400 volumes, many of them being rare and extremely valuable works.

The report of the Treasurer shows that our finances are in a satisfactory condition. The balance on hand at the close of the financial year is about the same as in his statement at our last annual meeting, and will all be absorbed by the expenses attending the remaining portion of the year. The question of rooms for the Society will have to be dealt with very soon, as the present quarters are too small for the library and collections and the meetings of the sections. It is to be hoped that the new council will be able to settle the matter to the general satisfaction.

The reports of the geological, microscopical and botanical sections are presented herewith. They have held regular meetings during the past season and have accomplished much satisfactory work. The ornithological section has become so much reduced in numbers that no meetings have been held, but it is confidently expected that there will be a revival of interest next year.

The Society was represented by the Rev. T. W. Fyles at the annual meeting of the Royal Society of Canada held in Ottawa in May last. His report is also presented herewith.

All of which is respectfully submitted,

W. E. Saunders,
Secretary.

Mr. Lyman read the report of the Montreal branch as follows :

REPORT OF THE MONTREAL BRANCH.

Annual meeting of the Montreal branch of the Entomological Society of Ontario.

The twenty-second annual meeting of the Montreal branch was held in the library of the Natural History Society, on Tuesday evening, 14th May, at 8.15 o'clock.

Members present : Messrs. H. H. Lyman, President ; Lachlan Gibb, Vice-President ; Geo. Kearley, and A. F. Winn, Acting Secretary.

The President presented the following report of the Council :

Report of Council.

In presenting their twenty-second annual report the council have much pleasure in congratulating the branch upon having unquestionably come of age,* and feel that so long a period of continued and unbroken existence is worthy of remark in view of the very small numbers interested in this pursuit.

During the year seven meetings were held and the following papers and communications were read :

An hour at Hochelaga, A. F. Winn.
Notes on the season of 1894, H. H. Lyman.
Note on the occurrence of Pamphila Manitoba at St. Hubert P. Q , A. F. Winn.
Mantis and Mantispa, H. H. Lymann.
How the forest of the district of Bedford was swept away, Rev. T. W. Fyles.
Note on the occurrence of of *Chionobas Tarpeia* in North America, H. H. Lyman.

Four new members have been added to the branch's roll and it is to be hoped that increased energy will be shown in the study of the many inviting subjects which this department of science holds out to those students who are really in earnest in the pursuit of knowledge.

The Treasurer's report shows that the finances of the branch are in a healthy condition.

Respectfully submitted on behalf of the council.

H. H. Lyman,
President.

*It was organized 16th October, 1873.

It was moved and carried that the reports of the council and Secretary-Treasurer be received and adopted.

The following officers were elected for the ensuing year :

President—H. H. Lyman.
Vice-President—A. F. Winn.
Secretary-Treasurer—Lachlan Gibb.
Council—G. Kearley, W. C. Adams.

The meeting then adjourned.

Lachlan Gibb,
Secretary.

Regret was expressed that no member had been able to represent the Society at the annnal meeting of the Association of Economic Entomologists held at Springfield, Mass., in August last. Through the kindness of Mr. L. O. Howard a full account of the proceedings has been received, and an abstract will be found in subsequent pages of this report.

Mr. Lyman exhibited a handsome quarto volume containing beautifully colored plates of the butterflies of Germany, which only cost, when delivered here, $4.59. It is entitled "Die Schmetterlinge Mittel-Europas," by Mar Korb, and is published at Nuremburg, Germany.

A paper was next read by Mr. Lyman on *Colias Interior*, the consideration of which was deferred to the following day.

The hour of 6 o'clock having arrived the meeting adjourned.

EVENING SESSION.

In the evening the Society held a public meeting in the City Hall,which was attended by between fifty and sixty persons, for the most part members of the Society. The chair was taken at 8 o'clock by his Worship, Mayor Little; on the platform were Professor C. C. James, Deputy Minister of Agriculture for Ontario, Rev. Dr. Bethune, Rev. T. W. Fyles, Mr. Dearness, Mr. W. E. Saunders and Dr. Roome, M.P. The Mayor opened the proceedings with the following remarks :

LADIES AND GENTLEMEN,—Our city has had the good fortune in recent years to be many times selected as the meeting place of conventions of fraternal and other societies and we are always glad to welcome them in our midst. To-night we have amongst us the representatives of a society, which, though provincial or Dominion in its character, has its headquarters in our own city and is therefore all the more welcome on that account. I am sure, although there are not a very large number present to-night, you will make up by your enthusiasm for whatever you may want in numbers. This Society has been quietly doing a very valuable work in our country. I understand that the journal which they publish is considered the most valuable work on entomology that is published on the continent of America and it is also the oldest. It is all the more interesting to us,because the Society was founded largely through the efforts of Mr. Bethune, who is on the platform to-night, and one of our own fellow citizens, Prof. Saunders, whom though at Ottawa, we still look upon as a citizen and we are proud of him and his work.. I therefore say this Society has a warm place in our hearts, because of its origin, and because it has remained among us. I am sure those who have come out to-night will not regret it.

Without any further remark I will call upon Prof. James of the Department of Agriculture, Toronto, to address the meeting. (Applause)

THE NEW AGRICULTURE.

BY MR. C. C. JAMES, DEPUTY MINISTER OF AGRICULTURE.

Mr. Chairman, Ladies and Gentlemen, and members of the Entomological Society, I believe it is somewhat of an innovation for the Ontario Entomological Society to hold an open meeting, or as we sometimes say a popular meeting, in connection with its deliberations. This, I take it, will have the effect of bringing the Society more into sympathy with the people, or rather of bringing the people more into sympathy with the workings of the Society. As a rule we find that the best men do their work most quietly. The men in this world who do the most advertising of themselves, who create the greatest stir for the time being, are not always the most important men in the world. So with regard to many of these societies, those who are doing their work the most quietly are very frequently the ones that are doing the most important work for the community. And the very fact that this Society for twenty-five years has been carrying on its work by itself, quietly, without creating very much stir, is not a condemnation of the Society, but, to my mind, the very fact that it is able to live after years of this quiet life shows it has that true vitality which will enable it to exist and to do good work in this world. (Applause)

We are not very many who are gathered here to-night, and what we have to say will be more in the line of a quiet talk between ourselves, more or less of a conversation one with another, with regard to the work in which we are interested. I propose to talk in regard to general agriculture and in connection with my remarks I may have something to say in regard to entomology and its relationship to agriculture. I do not consider that there is any more important question to be discussed or studied by city people, as most of you no doubt are, than this subject of agriculture. Some one may say that agriculture ought to be reserved for farmers and farmers' sons and families, and that the bringing in of the subject of agriculture at a town or city meeting is a great mistake. But there are two or three reasons that we can offer in connection with this, that are quite sufficient to warrant us in introducing a subject of this kind. In the first place we all admit that this country is first and foremost an agricultural country, that the progress of this country depends more upon agriculture than upon any other industry and that just as agriculture rises or falls so will the general prosperity of this country rise or fall with it. When the farmer is prosperous, has good crops and good prices, the people in the towns and cities feel the effect; and depression in the country is felt very soon in the city. Then again there is an old idea, now being rapidly removed, that agriculture after all is not a very interesting subject. The principal reason of talking to-night is to endeavor to show to you, in an indirect manner it may be, that after all there is a great deal of interest in agriculture for the people of our towns and cities.

There has been more or less talk of teaching agriculture in the schools and some have said it should be taught in the rural schools, but there are many people in this country who have looked into this question and who after thinking over it carefully have come to the conclusion, that agriculture should be taught in our city schools as well as in the country; that there is as much need for the education of our city pupils as for the rural in the subject of agriculture. Perhaps I may be able to show you, in a few cases at least, that agriculture is not that dry hum-drum business that many of us have sometimes thought it to be, but that connected with it are some of the most important and interesting questions that have presented themselves to the mass of human beings. We have heard a great deal of late in regard to many of the new questions, the *new woman* for instance has filled column after column of our city papers. Now it struck me in looking around for a subject that possibly I could not take anything better than this "*the new agriculture.*" (Applause.)

What are the changes that have taken place, or what are the forces that are present that have given us and are giving a new agriculture?

The first is the great increase of transportation facilities. Those of you who are older than the speaker here to-night will remember the time when transportation between the old countries of the world and this country was very slow. To-day we have the great continents connected by lines of steamers that run as rapidly as some of the accommodation trains upon our railroads. Nearly every continent in the world is belted by one or more great trans-continental railways. Even Russia is about completing a great trans-Siberian railway, Africa will be the next country to have a trans-continental railway. The result is that the world, so to speak, has been shrunken up and although we have these continents at distances of five to eight thousand miles apart and although we have great stretches of country such as this North America of ours, still with the improved steamship lines and railways, these countries have been so closely brought together that practically this world is now simply one great continent or one great country. What has been the effect of that? The effect has been that the great consuming markets have been brought closer to their sources of supply and it is not very much of an advantage now to be stationed a thousand, or two, or three, or four thousand miles nearer to the great consuming centres of the world, than some other countries. For instance Canada, because she is only some four thousand miles from England has not a very great advantage over Australia which is, I think, some twelve thousand miles away. South America is practically as close to Europe to-day as we are. Africa, both in the north and south is about as close to Europe as we are. There is very little difference in the cost of transportation over these great ocean distances and the result of it has been, that these countries with great territories of fertile lands, and with cheap labor, have been able to produce with almost equal facilities the enormous quantities of crude materials, such as wheat and oats and barley, and as a consequence the great consuming countries of the world are supplied as they have never been before. And the prices of these products have been going down lower and lower until we find that one great result has been that these crude products of the farm have been brought to the great commercial centres at very low rates Let me give you a couple of instances. It costs about thirty-four cents to pay all charges for sending a bushel of wheat from Manitoba to Liverpool, let us say half a cent on a pound. From Australia butter has been shipped to London at a rate less than two cents a pound. The transportation charges have been brought so low that it is possible to ship butter in refrigerator steamships from the dock in Australia to the dock at London for a smaller amount than it can be sent by rail from the north of England to the south. So that you see the great increase in transportation facilities has reduced distances; has brought the great producing nations of the world closer to one another, and they can now barter in the markets at about equal advantage one with the other. The result of this has been that the products that are of easy production have suffered in price as a consequence, and only those products which are more difficult to produce, which are produced by the more highly cultivated people, by a people with better facilities, with better training and better education, have been able to hold their own. Our farmers to-day are turning their attention more and more to the production of these higher classed articles, these articles which require more skill, because thereby they come less and less into competition with cheap labor and cheap soil. The production of these lower grades brings their higher priced labor in competition with lower priced, whereas the production of the higher classes, such as the best class of fruit and dairying production brings them into competition, not with cheap labor and cheap lands, but with the better class of labor and lands of Europe.

The second cause is the application of machinery. This perhaps might not at first sight present itself quite as forcibly to your minds as it will if I give an instance or two. The grains as we grow them, such as wheat and barley, have been raised from time immemorial. It is impossible to say when wheat and barley and grains of all kinds were first produced upon the earth. Go back as far as you will, you will find in history and in archæological remains the traces of the instruments for cutting have been shaped something like the curved arm, the sickle, and yet if you think, it was only the other day the sickle went out of use among civilized people. From the time that wheat and barley and oats were first produced until within a few years ago, the sickle, with practically little or no change, remained the sole reaping instrument of the human race. About 1826 a Scotch minister presented for examination to the Highland and Agricultural Society of Scotland a new machine, the forerunner of what we now know as the reaping machine. About the year 1831 Cyrus MacCormack brought out the first reaping machine in the United States. It was not until the year '41 or '42 after ten long years of experiment and changing and testing that this machine was finally put upon the market. It is only within the last fifty years that the sickle, the scythe and the cradle after being used for so many centuries have been superseded by the reaping machine. All at once what wonderful developments began. The reaper and the mower, and then a very few years ago came the self-binder, and we have to-day in California the harvester and header machine, drawn by from eighteen to twenty-four horses or mules, which reaps and threshes the grain and leaves it in bags on the field. The question we ask ourselves right here is, "What next?" One hesitates to say or give an answer to that question when we see what has happened, what wonderful steps in progress have been made from the simple sickle or scythe to the self-binder. When within the period of thirty or forty years such wonderful evolution has taken place after a long period of quiescence, one may say, what will be introduced next?

Take another instance. In connection with dairying the method in olden times of churning the milk was by a very simple operation, either by means of a bag hung up and pounded or swung around, or else in a vessel quite similar to our old-fashioned barrel churn. It is not very many years since the old-fashioned dash churn and implements of this kind were used for the manufacture both of butter and cheese. Then someone introduced the application of power, such as horse power, steam power, the introduction of the box churn and one after another applications of the various kinds of machinery began to be made, till now what have we to-day ? We have a machine that can be set up in the barn to milk the cows. Although this machine is in an undeveloped condition, nevertheless it does its work and proves we are on the right track. That milk drawn by a machine can now be put into another machine and by means of it the skim-milk comes out of one spout and the cream out of another. This cream can be put into another vessel or machine, and by proper temperature and the addition of a substance somewhat resembling yeast, a fermentation can be started, and just that kind of fermentation that we desire in connection with it. After the fermentation has gone on a certain time this can be put into another machine and churned, and after churning it can be worked and packed by machinery. So that now it is possible, although not altogether practical, from the very milking to the putting of the finished article on the market, to do the whole of the work by machinery. This wonderful progress has taken place within the last quarter of a century.

As we look at farming in its different aspects, machinery has been applied at this point and that point, and agriculture is being put on an equality with the manufacturing establishments of our towns and cities. You ask yourselves this question, "Why have our great manufactures in the towns and cities developed ?" The principal reason for this is in the application of machinery to the work. Why is it that machinery has been developed in connection with all these other industries and yet it has taken so long to bring the attention of inventors to the work of agriculture ? Well, one reason is that there has been no great necessity for it until recent years. We sometimes hear it said that the men are leaving the farms because they are not required, because so much machinery has been brought in that a man with a machine can now do as much work as a man and two hired men could do before. There is another side to that question, viz., because of this drawing away of so many farmers' sons from the farms to the towns and cities, because of the want, therefore the supply of machinery has been produced. Both of these things no doubt have been effective. That is, machinery has been produced because it has been required ; and people have left the country since they were not required because of the presence of machinery. According to the census of 1891 there were farmers and farmers' sons in Canada to the number of 649,506, in 1881 there 656,712. From '81 to '91 the number of farmers and farmers' sons in Canada decreased by over 7,000, yet during that period we had the opening up of Manitoba and also of the North-West, and the agricultural product of Canada is greater to-day than it ever was before. If you put these two or three facts together you can easily see the great part machinery has been playing in connection with agriculture in Canada for the last ten years. Although the number of farmers decreased to the extent of 7,000, nevertheless the total output of agriculture has vastly increased. This is owing to a great extent to the application of improved machinery in connection with agriculture.

The next point in connection with agriculture that I wish to refer to is one that comes as a sort of rider to the last ; a companion to it, namely, the application of science to agriculture. Now, in certain quarters the moment you begin to talk about the science of agriculture and scientific farming an objection is raised and people say there is nothing scientific about it, it is all practice, and when you find a scientific farmer you find a farmer who does not make much progress.

I desire to give a few facts to show that science has been applied quite successfully to the improvement of agriculture in this country, and further, that just as we bring to bear upon agriculture the latest and best developments of the different sciences, so we may expect agriculture to make improvement. One of the great reasons why agriculture remained on a dead level for so many centuries was simply because the attention of scientific men had not been directed to agriculture as a field for investigation. *Scientists* had been expending their time and energy with the work that is carried on in towns and cities. To-day we find as much attention being paid to the science of the calling of agriculture as to anything else, and the result has been wonderful progress, a wonderful development, which has begun of late and which is now in progress, and the result of which we can hardly forecast at the present time.

Let us take two or three illustrations: We sometimes hear it said that there is not very much in agriculture, that it is a dry subject, with nothing interesting in it, that it belongs so to speak to the common people and not to the literary class; there is nothing about it likely to attract the attention of people. Now, I will give you an illustration, which probably you may have had presented to you before. It has been known for years that there is wonderful difference in different crops, in the methods of their feeding. For instance, they say clover will feed in one way, that wheat will feed in another, that our common grasses of the field feed in another, and because of their different methods of feeding, therefore, it is advisable that we rotate crops, one kind one year, another kind another year. We can perhaps illustrate that by representing before us here a large table. Suppose a long table were set up in this room, filled with all manner of food, and you as an audience were asked to sit down at the table to partake or taste, and to take all you would want to eat. No two of you would want to eat the same kind of food. One man would have a preference for fruits; another man might have a great preference for meats; in fact there would be a choice in the kinds of meat. Your tastes differ; your methods of feeding differ. After you were through, if you will allow the comparison to be taken to a little lower level, suppose we were to bring in some animals of another kind whose tastes were different from ours, they would be able to take from what was left. Still there would be a portion of the food they would not take, and we could bring in something else and finally the scraps might be thrown out to the poultry. So if you alone were to be fed upon that food there would be a considerable amount that would not be taken; you could not make use of it, but what you did not want some other animal would devour; what the second class of animal would not devour the third would. Here is a large feast, so to speak, prepared by nature for plants, and we put one kind of plant upon that soil this year. It has a preference for a certain class of food and takes it, and next year another kind of plant is put upon that field which has a different feeding capacity from the one of the preceding year and that plant takes what the other one does not want, and so on by rotating year after year, for three or four or five years, we are able to satisfy the wants of all, whereas if we kept on with the one plant year after year, we would have exhausted the particular food of that one plant and the rest of the food that was there would have been left lying idle all the time. Many farmers in years past, thinking the soils of this country were entirely inexhaustible, put in wheat this year and wheat next year and so on, until finally they were forced to the conclusion that there was nothing left for the wheat and they have taken their attention to other things. We find in many cases what was once a first-class wheat farm became a very poor wheat farm, and then after a number of years that poor wheat farm has become a first-class dairy farm, because different crops have been grown for milk, butter, and cheese.

I want to refer more particularly to one of these plants, viz.: Clover. I do not think there is any plant that presents a more interesting study, interesting though they all may be, than this much neglected and underrated clover plant. It was found that it fed in a different way entirely from the wheat, and then the question that presents itself to the minds of some of these much despised scientists is, in what way does that clover plant live? How does it differ in its feeding from other plants? After a long and careful examination, some came to the conclusion that it got most of its nourishments out of the air. Others concluded because it had a long root and it could go down into the sub-soil, that it got its nourishment there. They finally found something that had escaped the attention of most examiners, in connection with the roots of the clover plant upon which there were little knots or nodules. Now, I suppose hundreds of thousands of clover plants had been examined and these little knots had been seen. Someone who was a little more inquisitive pushed his question a little further and began to ask himself this question seriously: "Now this little bud or nodule on the roots must after all play some part in the economy of this clover plant." And to sum the whole thing this has been the result of investigation; that these little knots are filled with very minute organisms very difficult to describe, very minute specks somewhat similiar to the very minute specks we find in yeast These are living in the roots like little parasites and the effect of their living there is to take up nitrogen from the air and in some way to give it to the plant for its subsistence, so that whenever one of these nodules comes on the clover root we find it has the means of taking up food out of the air, and then when we turn over the plant and allow it to decay in the soil, we put in the soil a certain amount of food that this plant has taken up out of the air; and the result of it is there is an excess of food there for the next plant that comes along. Now the wheat does not possess that little nodule and it does not take up the nitrogen out of the air, and the result has been that, that little investigation,—little we may call it, yet momentous in its results—has established the practice of preceding the wheat crop by a crop such as clover, or peas or beans.

Let me give you one instance in connection with entomology which has seemed to me since I read it some years ago, almost like a fairy tale. I will give it to you just as it stands. About eight or nine years ago the complete destruction of the orange groves of California was threatened by the spread of an insect known as the cottony-cushion scale. This insect was covering the limbs of the trees and the result was the vitality was being sucked right out of these trees by millions of tiny insects. The pest got completely beyond the control of the fruit growers of that country and in their despair they appealed for help to somebody or anybody. Professor Riley who was in charge of the Entomological Department at Washington, and who unfortunately met his death this year,—one of the greatest benefactors the American people has ever known —at once began the investigation of that question. Being an expert entomologist he knew practically every country in the world where that scale insect was common and he knew that the most likely place from which it had come was Australia. It had probably been introduced some twenty years before that, in bringing in fruit trees or vines from Australia. He however knew it had never become a pest in Australia. Now if it is found in Australia and later found in California and has become a pest in California and has not become a pest in Australia, he concluded that there must be something in Australia that will stop it, so he despatched two assistants to Australia to investigate it and they sent back consignments of lady-bug beetles or lady-bugs as they are commonly known. You have seen these running back and forth over the leaves and branches of the fruit trees doing great destruction to the other insects. Within a very short time, less than a year although these scale insects had been increasing for twenty years and practically had the products of California by the throat, and in fact had taken possession of the country; in less than a year, this little lady-bug increased to such quantities that it swept the scal out of existence or got it into such control, that the fruit interests of California wer- saved. (Applause). I do not suppose that anybody could sit down and figure up th amount of money that was saved or made for the United States by that simple littl insect brought in by a man known to very few present. You do not see his name prom nent in the newspapers. The fact was not heralded broadcast in great flaming type. H was not given any great ovation. It is a question whether any monument will be erecte to him by the United States, yet it is doubtful whether the United States has had an greater benefactor than that man and his associates.

Take the potato bug, what would we do to-day if we did not know that simply by dusting Paris green on potato plants we could effectually head off and kill the potato beetle. We could not raise potatoes at all. Where has that come from? It was not picked up by chance, somebody did not sit down one day and write to the paper that he thought that if you dust the potato bug with Paris green you would stop it. Back of that was careful investigation by these same men who study the habits, mode, and living and all about the potato bug. We might go on and give instance after instance. A great many of the various methods that are being practised to-day, many of the best practices we have in connection with agriculture to-day have come, not by hap hazard or by chance, but have been worked out by men on small salaries, working in obscure places, who have devoted themselves to their work with such energy as we have not had surpassed in any other calling, I care not what one you mention.

What a large portion of our reading is monopolized by a few things. I suppose the people of London know how much importance is attached to politics. It seems to be necessary the world over to have politics, but there are other things that are constantly filling the newspapers. What does that prove? That the people want to hear about these things, that the people have their attention taken up with these things, yet it is not very often that you find the most valuable columns of the newspapers given over to some great agriculture event, unless it may be in the case of agricultural depression or crop failure where there is something that is going to effect the finances of the whole country.

The point I want to make is this, there are lots of things happening in connection with agriculture, that are far more important to the prosperity of the country than these things which seem to occupy such an important place in connection with public attention. I have brought along with me a picture to illustrate that. Last summer, many of our Canadian papers were interested in a discussion, as to whether the American Society of Colonial Wars should be allowed to go down to Louisburg, Cape Breton, and erect a monument to commemorate the taking of that place by the Americans, British Colonists, as they were at that time. If I remember correctly some 150 years ago they occupied the place and held it for a short time, and then the French people took it back again. Now that event has cropped up again, after a period of 150 years. That event has been made so important to a large class of the community that they felt themselves constrained to raise a large fund, to get together a large excursion party, and to journey to Louisburg and erect that monument. It created so much attention at the time that it was a matter of doubt as to whether the Canadian Government ought to allow these people to go over there and erect the monument or not. This picture was sent me by Mr. Thompson, of Massachusetts, and I will just read you the inscription upon it. It is doubtful whether half a dozen in this room have ever seen this in the newspapers, or whether they know such a monument was erected. "This pillar, erected in 1895 by the Rumford Historical Association, incorporated April 28th, 1877, marks the estate where in 1793 Samuel Thompson, Esq., while locating the line of the Middlesex Canal discovered the first Pecker Apple Tree, later named the Baldwin." Now, I will submit it to you as to whether it was of more importance to the country to capture and hold for a short time, that little point down there on Cape Breton, or to discover the "Baldwin Apple." That Baldwin apple was discovered in 1793, and at the present day if you pick up in the fall of the year, just about this time, the market reports in Liverpool, you will find a few kinds of apples mentioned. Greenings so much a barrel, Spies so much, Baldwins so much. Practically from that day to this the Baldwin apple has been produced over the Eastern and Western States, and in Canada, and has been bringing in year by year a large amount of money to the American people. And yet events of that kind are practically lost sight of; whereas events such as I have spoken of, are blazed forth to the country and the minds of the people are filled with it. Now it seems to me these things are out of all due proportion. Probably we cannot rectify them, yet the point I want to make here is that there are a great many things happening, there are a great many conclusions being arrived at in connection with the prosperity of this country that are entirely overlooked, whereas other events that are of little consequence after all, are magnified and fill column after column of the newspaper. What is the result of this? Suppose you ask the boys and girls in the rural parts, and the boys and girls in our towns and cities, what effect the reading of these matters has upon their minds? Is it not a fact that it suggests to their minds the paramount importance of politics and such things as concern town and city life. The result is their minds become filled with the events of town and city life; their inclinations are drawn off in that direction; the ties which bind them to agriculture become cut one after another, and the ties which lure them away become greater and greater, till we find a great many of these, to their discomfort afterward, are lost to agriculture and a great many men who would have made first-class agriculturalists, are drafted off in other lines of work to take second and third-rate positions.

The last point I desire to touch upon in connection with this new agriculture, is that during the last ten or twelve years, to say nothing about the past twenty-five years, there has been wonderful development in connection with the facilities for acquiring information in regard to agriculture. These things that I have mentioned I have no doubt will be righted some day, and before long you will find the histories of this country will not be filled merely with accounts of men killing one another, they will not be filled merely with the names of persons who have occupied positions in towns and cities, but you will find there the development of the people traced. A gentleman came to me the other day who had for sale a book, dealing with the history of this country. He said: "You will find there everything in connection with this country." I said: "I will be very glad to get it, I have been looking for a great many things and have not been able to find them." Now, before you go away we will just try it. I said: "When was the first Agricultural Society formed in Ontario? "I don't know," well, I said, "that is of importance, is it not?" Is there any organization or institution that has done more to build up and develop the country, until probably within the last four or five years, than the Agricultural Society? It is of as much importance to know as when a certain kind of industry was established in some town or city. I have been on the search for it for the last five years, and finally I think I have nailed it down. There is an utter absence of all these facts in regard to the agricultural development of the country. Until we come down to the period of twenty-five or thirty years it has almost all disappeared. They can tell you of the men who have been elected to Parliament from the very first up to now. They can give you the vote that was polled in connection with any election. They can tell you, perhaps, when a certain new kind of machinery was brought into the country. They cannot tell you when the first improvement was made in connection with live stock, when the first thoroughbred live stock came into the country. I say that it is of much importance to know when these agricultural industries began and how they developed, because on these, rather than the others, the prosperity of this country has been built up. My point is, there ought to be a proper balance between these things and our histories should not be filled with other events to the exclusion of those which are equally important.

A wonderful change has taken place in the facilities for carrying on experimental work and getting an agricultural education. Take this province, we have the Agricultural College at Guelph and the Experimental Farm at Ottawa, from which our friend Mr. Fletcher comes. We have a school or college of agriculture at Kingston, and now we have a dairy school in the west at Strathroy, so we have four points in this province from which comes information in regard to some of the later developments in agriculture. Then we have six or eight different points at which experiments in connection with fruit growing will be carried on, and there is a great development along that line. Before long we will have this province dotted over with little stations from which the latest information may be obtained, and each of these will be a centre leavening the whole surrounding country.

Then we have the societies. Beginning with the time of the organization of the Province of Ontario in 1867, we have from then on had the organization of society after society, till now we have three dairy associations, two poultry associations, the fruit growers, the bee-keepers and the sheep-breeders and the swine-breeders, and a great many other stock associations, and last, but not least that association to which we are indebted to-night for this meeting, the Entomological Society which has now been carrying on its work most successfully for the last twenty-five years. I think these societies have all been accomplishing a great deal of good in this country. Some may say they do not get any great benefit, they do not come in immediate contact with the Entomological Society, but each one of these men so to speak becomes a source of information and as they go from these meetings to their homes, to this point and the other, they give out their information. They also come in contact with other men through their writings.

This Society has been quietly doing one of the most important works in connection with agriculture in this province. If these gentlemen were not present I might say something even a little more flattering with regard to them. I have had occasion from year to year of examining the reports of their meetings which they have sent out, because *they are* published in the department to which I am attached and I can simply say this, that if the work of all the other societies was as well done as the work of this Society our labors at Toronto would be very much relieved. When the report comes in it is ready at once to go to the printer and we have no further work in connection with it, and year after year when I read that report I have been astonished with the amount of work that has been condensed and packed away. It is not a padded report, it is a report full of information. In looking over the list of persons to whom it is sent I find it has gone to almost every corner of the world. These men have not been content to hide their light under a bushel, but their work has gone out into every province, and has gone out into the whole world. Someone may say, "I do not see any good in finding out what is the peculiarity of certain insects or finding out just how they live." I do not see any good result coming from the work of the bacteriologist who studies with the microscope things small, so that if you were to take up a drop of milk on the point of your penknife and were able to count its inhabitants you would find 1,000,000,000 of these living plants in that drop of milk. The whole system of dairying has been revolutionized by the work of that man who is sometimes called unpractical.

Whenever I hear any of these objections I sometimes think of a saying of Franklin. Franklin you remember in connection with his experiments in electricity sent a kite into the clouds. He told the people that there was electricity up there and they laughed at him. He sent up his kite but the electricity did not come down. However, fortunate for the occasion, we are told, that the kite went up into a black, dark cloud which he positively felt was filled with electricity. Shortly afterwards the rain began to fall. It came down wetting the kite and trickling down the string. Then the hand that held the wet string began to feel the throbbing of the electricity; he proved it to them and they said. "What is the use of it?" And he said. "What is the use of a baby? It will grow to be a man." So in regard to many of these inventions or discoveries or conclusions that the entomologists, and chemists and botanists, and bacteriologists, and biologists and other scientists may find with regard to agriculture. Their discoveries are in the condition of Franklin's baby, and if we will only wait and have faith in the work we are engaged in and give true encouragement and sympathy, some of us at least may live to see these scientific babies grow up to be good, strong, stalwart men in connection with the practice of agriculture in which we are so much interested. (Applause).

At the conclusion of Prof. James's address, which was listened to with great attention and heartily applauded, Dr. Bethune rose and said:

MR. MAYOR, LADIES AND GENTLEMEN,—I propose that we offer our very hearty thanks to Prof. James, for the able and interesting address which he has just given us. Prof. James has come, I am sure, at a grest deal of inconvenience to himself on purpose to be present with us here to-night, and to encourage us by the remarks which he has made, and also to give us a great deal of very valuable information. While thanking him for his address to-night I should also like to take the opportunity, as one of the original members of this Society, to express the gratitude that our Society must necessarily feel towards the Department of Agriculture for Ontario, of which Prof. James is Deputy Minister. He has remarked this evening that our Society has been in existence for twenty-five years and the Mayor has also mentioned to-night, that our magazine, *The Canadian Entomologist*, is now the oldest magazine touching on the subject, upon the whole continent of America. But I wish to let you know one reason why our Society and our magazine have survived so many others that have have started in the United States and Canada and that is, that we have been so greatly helped throughout nearly the whole of our existence, by the Department of Agriculture for Ontario. (Applause.) We began in a very small and humble way with a little magazine of eight pages that was to be published whenever we had enough material and enough money, and we had fourteen members, all told, when we began. And we managed like many other societies to struggle on, but unlike most societies of this kind, we have not died a natural death in a few years. The Department of Agriculture came to our assistance, and gave us a small grant at first, which was subsequently greatly increased, so that while a number of years passed, we have been able to hold our own in the domain of science in North America and to spread our publication, not only all over the continent but, we may safely say, to the ends of the earth. We have correspondents and subscribers in every part of the world, including even South America, Australia, India and Japan, as well as the different countries of Europe. I trust you will unite with me in expressing our thanks to Prof. James. (Applause.)

THE VALUE OF ENTOMOLOGY.

Mr. JAMES FLETCHER, Entomologist of the Experimental Farm at Ottawa, spoke as follows:

Mr. CHAIRMAN, LADIES AND GENTLEMEN,—It is my pleasure and honor on this occasion to represent as well as I can a far better man than myself, namely, the President of our Society. After all the kind words which have fallen from the lips of our esteemed lecturer of the evening, the Deputy Minister of Agriculture, it is difficult to give a resume of the work and objects of the Entomological Society of Ontario without repeating something which may already have been better said. Our Society stands in the position of a Division of Entomology to the Department of Agriculture and Arts, and it is the wish of every member of the council that our work should be of the greatest possible utility to the country at large. The work done in the past has been of an excellent nature, the prosperity and utility of the Society having year by year increased, and I am happy to be able to say that, at the present time, the Society is in a more prosperous condition than it has ever been before. We have a body of active, enthusiastic workers and every equipment for good work—valuable collections of insects, as well as a first-rate botanical collection, a magnificent library, and, in addition, active branches working up not only entomology, but also many other kindred branches of science. The condition of our library is rather remarkable. It is undoubtedly the best library of works on natural history in Canada and one of the best in North America. Now I am quite certain, Mr. Mayor, that the citizens of London are not aware of this fact; they do not know of the valuable collection of books on natural history and the grand museum of insects and plants which are deposited here in their midst, but which specialists are glad to come from all parts of Canada to examine. Some people may say, "What is the use of these collections of insects and plants? They are pretty, it is true, but what is the use of them?" In reply, I would remind such enquirers that these objects are but means to an end. The main object of our Society is to prevent loss to the farmers of Ontario from the attacks of insect pests. The enormous losses which take place in the crops of the province every year from the depredations of injurious insects, can only be controlled by specialists first studying up and understanding the habits of the insects which cause the damage; for this purpose collections of various orders of insects for study and comparison are essentially necessary. Moreover, by collecting and studying all the members of a family, we may frequently anticipate and prevent injury by one species from knowing the habits of an allied member of the same family. We aim then to make our collections as complete as possible and look forward to the time when some day we may have in our cabinets representatives of all the injurious insects which have given trouble in Canada. These are matters of interest to the citizens of London, which place has always been the headquarters of our Society; and my advice to those of you who have not yet found out what treasures you have among you, is to go and find out as soon as possible; it is worth your while, and I can promise you that you will at all times meet with a courteous reception from our Curator, Mr. J. Alston Moffat, who will gladly show the many beautiful objects in his charge to anyone who is interested enough to call upon him.

Some striking instances of the usefulness of the study of entomology have already been well laid before you by Prof. James, and there are numerous others which might be cited. If any proof of the matter were needed, we have merely to think of the large number of official economic entomologists employed by the leading nations of the world, and to notice how the study of injurious insects is fostered by the most practical people on the globe to-day, the Americans, who indeed were the first to organize a systematic study of practical entomology and fungology. These two branches of knowledge are certainly worthy of much study, for they are the two chief causes of a reduced output, in other words, loss of revenue, in every country of the world.

The losses in the agricultural produce of a country every year due to the ravages of insects are said to be ten per cent. of the whole amount, and there is a further loss of ten per cent. caused by fungi parasitic on plants grown by man as food for himself or his stock. Familiar examples of such parasitic fungi are the black spot of the apple, smut of wheat, oats, barley, etc., grape mildew and potato rot. All of these are diseases which in the past have been the direct cause of the loss of large sums of money, but which now, owing to the studies of specialists, can all be to a large measure controlled by practical methods, cheap, simple and effective, which can be used by every farmer in the country possessed of ordinary intelligence. The same thing is the case with injurious insects. Of those kinds which every year attack our crops and reduce our revenues, by far the larger proportion have been studied out so fully, by men such as those who form the membership of the Entomological Society of Ontario, that at the present time practical remedies are available for all who will take the trouble to ask for them or who have kept themselves posted in the matters which concern vitally the success of their business. But these facts are not appreciated generally by the people most concerned, the agricultural classes. It is an old but true saying:—"We only miss the water when the well runs dry." As a rule, farmers only think of remedies when they find their crops seriously attacked, and they then find that in many cases it is too late to prevent loss. Many of the most successful means of protecting crops are methods of prevention and must be put in practice long before the crop to be protected has reached maturity. The farmers of Canada are much to be envied; for they have advantages not surpassed in any part of the world. Yes, sir; not only have we here the glorious climate and magnificent soil necessary for the production of the best agricultural products; but we have as well wise Governments who are doing everything possible to help us in making our operations successful. We have our most active and useful Department of Agriculture, at Toronto, which publishes every year in its annual report, the latest developments with regard to all subjects brought before the various societies subsidized by the Government; these deal with many different agricultural matters, such as our own Entomological Society of Ontario, the Fruit Growers' Association, the Bee-Keepers' Association, the Sheep and Swine-Breeders' Association, Farmers' Institutes and many others. All of these associations receive grants, and the Government publishes their reports for the good of the farmers of the country. Besides this, we have the Agricultural College at Guelph, a grand institution doing excellent work; and, above all, we have the Dominion Experimental Farm system maintained by the Federal Government, which is constantly at work trying to assist the farmers of Canada by testing and examining all subjects which it is thought may better their position and prospects. The publications of all these institutions are issued free of charge and distributed with a liberal hand. In fact I believe, as I have already said, there is no country in the world where more is being done in a wise way to help farmers than is the case to day in Canada. (Applause.)

Is it not folly then on the part of any man in this country not to apprise himself of these facts and put them in practice? To bring the matter back again abruptly to the work of the Society under whose auspices we are gathered here to-night, is it not folly on the part of any farmer in Canada not to find out what are the latest developments—or, as Prof. James has put it, "what is the new agriculture,"—with regard to the best methods of protecting himself from loss and of saving his crops from the attacks of the hordes of injurious insects which are ready to levy so heavy a tax upon all that he grows?

Many instances might be cited of the good results which have followed the diligent work of entomologists.

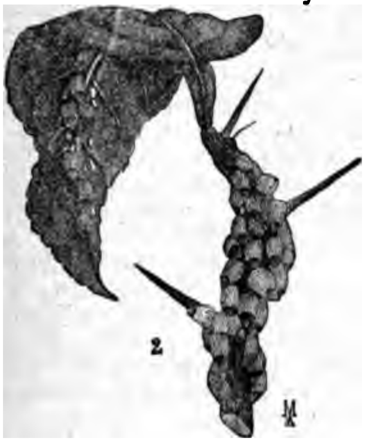

Fig. 1.

Prof. James has already referred to that delightful incident by which the very existence of a lucrative industry, the cultivation of oranges and other citrus fruits in California, was saved from extinction. This was done by the timely introduction from Australia, by the United States Entomologist, Dr. C. V. Riley, of a small parasitic lady-bird beetle (*Vedalia cardinalis*, Muls.) which preyed upon the injurious Fluted Scale *Icerya Purchasi*, Maskeil), Fig. 1, an insect which threatened at one time to destroy all the orange groves in the Pacific States. Another instance of good work of particular interest to Ontario farmers, was the practical remedy first hit upon by Mr. L. O. Howard, now U. S. Entomologist, for fighting the Clover-seed Midge. Our farmers in Western Ontario now cut or feed off the first crop of clover about June 20th, to prevent injury to their seed crop by the Clover-seed Midge. This is undoubtedly the best method of preventing loss, but they do not think that the knowledge of that one fact, which is worth at least half a million dollars a year to Canada, was due to the carefully studied investigations of one man. They know nothing of the arduous and unremitting work which was necessary before the different dates at which the insect passed through its various stages, were definitely fixed; but, when this was done, it was at once possible from this knowledge, to suggest an easy and very effective remedy. The Clover-seed Midge is a minute gnat

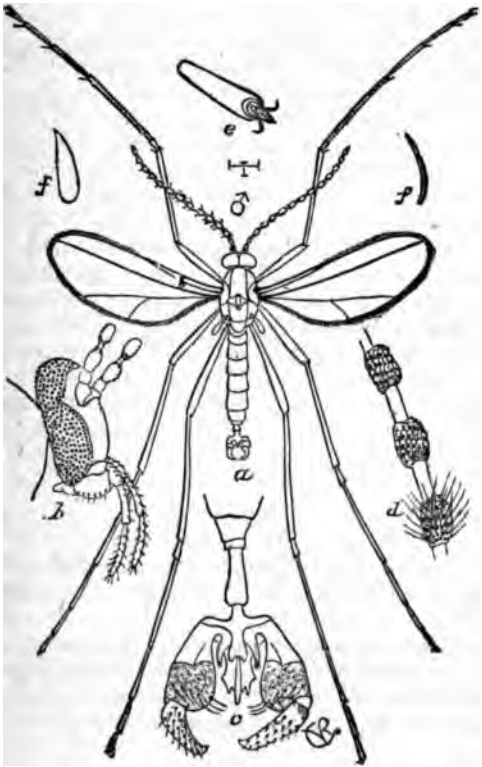

Fig. 2.

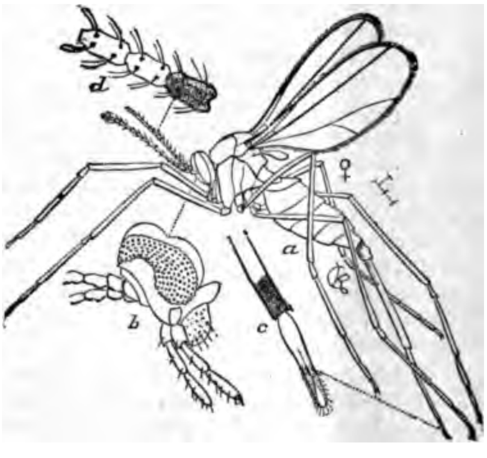

Fig. 3.

(Figs. 2 and 3) which lays its eggs in the forming flower heads of the clover plant in May or early in June and again during July. There are thus two broods of this insect in a season. The larvæ (Fig. 4) of the first brood attain their full growth about the end of June, when they leave the clover heads and go into the ground a short distance to complete their transformations, the perfect flies appearing about the middle of July. The eggs laid by these midges produce the second brood of larvæ which destroy the fall crop of clover seed. Part of this brood matures in September, but the remainder not until the following spring. Experience has taught farmers that the remedy suggested of feeding off their clover fields with cattle and sheep until the beginning or middle of June, or cutting it by the 20th of the same month, is the only way to secure an autumn crop of seed; thus, the grubs of this first brood (the eggs of which were deposited on the growing clover as the heads formed) are destroyed by the cattle eating them, or they dry up with the clover hay which has been cut before they were mature enough to leave the heads of clover and go into the ground to complete their stages. If the clover is left standing in the fields till the end of June, a sufficient time elapses for this latter process to take place, and the perfect flies emerge again just in time to lay their eggs in the opening flowers of the second crop. In this way, the seed of the second crop is destroyed as well as the first.

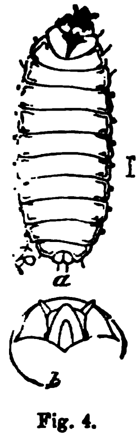

Fig. 4.

Few appreciate the fact that many of the common remedies which have now come to be pretty generally practised all over Canada, were the outcome of much labour and unremitting attention on the part of men who had devoted years of close study to the matter. The farmer who saves his crop of potatoes by dusting or sprinkling them with a mixture containing Paris green, has small thought for the continuous effort and numerous trials which were necessary before the insecticidal properties of this useful substance were discovered. Paris green, the standard remedy against all mandibulate or biting insects, is a chemical combination containing chiefly arsenic and copper, about 60 per cent. of it being arsenic. It is to this latter it owes most of its virtue as an insecticide. It is, I think, almost an ideal material for the purposes to which it is applied by entomologists. The danger of its being mistaken for some other substance of a harmless nature is reduced to a minimum by its characteristic bright green colour, the colour green being very generally recognized as indicative of poisonous properties. Its insolubility in water and under most conditions to which it is likely to be exposed, renders its use very simple, although this fact also necessitates the constant agitation, during their application, of all liquid mixtures containing it, in order that the Paris green, which is very heavy, may be kept in suspension uniformly through the whole liquid. Its fine state of division makes its dilution either with liquids or dry powders very easy, and its extreme virulence as a poison makes it possible to dilute it very much indeed without loss of its efficacy as an insecticide. It has been discovered of late years that, by mixing an equal weight of quick-lime with this arsenite, the caustic effects which sometimes follow its careless use on vegetation, can be in a large measure prevented. This discovery has simplified immensely the question of the most suitable remedy for mandibulate insects; for now a standard strength of one pound of Paris green, one pound of quick-lime and 200 gallons of water may be recommended for use on all kinds of vegetation. If it be thought more convenient to apply the poison in a dry form, it may be mixed with fifty times its quantity of any dry and finely divided powder.

The easiest way of applying Paris green to orchard trees is in a liquid mixture, by means of a force pump with a spraying nozzle. The good results which have followed the adoption of spraying as a regular orchard operation, have been so remarkable that it is now practised by all progressive fruit growers. There are various kinds of spraying

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* Fig. 2*a* represents the male midge enormously magnified; *b*, the head, and *c*, the peculiar clasping organs still further magnified; *d*, the joints of the antennæ; *e* the claws; *f f*, forms of the scales which are distributed over the wings and body. Fig. 3*a*, represents the female midge similarly magnified; *b*, the head; *c*, the tip of the ovipositor; *d*, a portion of one of the antennæ. The small lines beside the figures give the natural size of the midge. Fig. 4*a*, represents the larva; *b*, the head withdrawn into the first segment. These figures are from drawings by the late Prof. C. V. Riley,

pumps and nozzles, and the latter are quite as important as the former. We have now several good pumps manufactured in Canada; but the best nozzles are the Vermorel and the MacGowan. The former is a modification of the Cyclone nozzle, invented by Prof. Riley and his staff, of the United States Division of Entomology; the principle of this nozzle is that the liquid is forced tangentially into a small chamber, so as to strike the other side of the chamber; it is then forced through a minute central orifice, which has the effect of breaking up the liquid into a very fine spray. Too much importance cannot be attached to the fact that the liquid must be broken up into as fine a spray as possible, so that a very small quantity of the liquid may be used, and that it may be carried all through the foliage and left as a fine dew on the whole surface. In this way sufficient of the poison is deposited to destroy the insect enemies; at the same time, little is used, and there is no injury to the foliage.

During the past summer, there has probably been considerably more spraying done than ever before. This is largely due, of course, to efforts that have been made to bring this excellent method of preventing loss to the notice of fruit growers at the proper season. In Ontario much attention was drawn to the subject last year by some experiments carried out by Mr. John Craig, Horticulturist to the Central Experimental Farm, in a few orchards of Western Ontario. These experiments were very much extended and vigorously prosecuted during the past summer by instruction of the Hon John Dryden, Minister of Agriculture, who recognizes fully the value of this work to the province. The operations were put into the efficient hands of Mr. A. H. Pettit, who visited a great number of stations throughout the province, giving instructions and superintending the spraying of the orchards at regular intervals. The full account of this useful work will be published by the Department; but I many mention that Mr. Pettit has informed me that, on the whole, they have been very satisfactory.

In view of all that has been done by the Government of the country to distribute accurate information as to the best way of preventing injury to fruits by insect and fungous enemies, it certainly is a disgrace to our Canadian fruit growers that apples and other fruits are exposed for sale in this country, and exported to foreign markets in the spotted and blemished condition that is frequently the case. It is disgraceful because it is unnecessary. The two enemies, which are the cause of the greater part of this injury, are the Black Spot, a fungous disease, and the Codling Moth, the larva of which is the well-known "apple worm" Satisfactory remedies for both of these have been found; the Bordeaux mixture tor the former, and Paris green for the latter. The cost of spraying these washes over the trees is very little, compared with the great saving which is made in the quantity and quality of the fruit harvested. Although it is true that the number of different kinds of insects which may attack our crops is very large, the actual number of those which are likely to appear every year is comparatively small; of these by far the larger proportion have been already studied and remedies have been published in the official reports, which are available for all who ask for them.

Before closing I must refer to one more subject, namely, the Horn-fly of cattle, which, of late years, has done so much harm among our dairy herds, but about which, from knowing the details of its behaviour since it was introduced into America, entomologists were at once able to give encouragement to dairymen, that in a year or two the virulence of its attacks would be much diminished. This prediction, I am glad to say, has proved correct; while, two years ago, in this very district, the loss in milk supplied to cheese factories was stated to be nearly fifty per cent. of the whole supply, last year it was much less, and during the present season, as far as I can learn, it has been brought down to only five per cent. Next year and thereafter, I hope confidently, that the annoyance from this insect will be reduced so much as to require no more attention than is given to-day to the ordinary cattle fly (*Stomoxys calcitrans*, L.)

Now, Mr. Chairman, I maintain that all this saving, to which I have referred, has been brought about from the development of the *science* of entomology. Science is a terrible word in the eyes of some people; but, after all, it is merely an illustration of the affectation of the age; some people like to use long words where short ones would do as well or better, or to use Latin where plain English would do. Science is a Latin word which means simply knowledge, and it has been given the special signification of exact knowledge, or the best knowledge. I presume this was what Prof. James meant when he explained to us that the new agriculture was simply an outcome of the necessity, now-a-days, for farmers to have the best possible knowledge and education upon all subjects affecting their calling. I feel sure that everyone here was pleased to hear his kind words about the different societies he referred to, and most particularly proud of what he said of the work of this Society. There is no doubt that special knowledge is now necessary for farmers to compete successfully in the struggle of life. I noticed a statement in the newspaper this morning which well illustrates this fact.

Prof. Henry, one of the best known teachers of agriculture, who is at the present time doing good work at the Wisconsin Agricultural College, obtained his position owing to his practical knowledge of all the details of farming. He has always held that the best men and the best knowledge were necessary for successful farming, and used it as an argument for farmers' sons to remain on their farms and study farming in earnest. There was a vacancy at one of the other agricultural colleges for an agriculturist, and, the story goes, that Prof. Henry was asked if he could send a suitable man to fill the post at $1,500 a year. His answer was that he regretted to say that he could not then find a man properly equipped with all the necessary knowledge of farming, but that if it had been a lawyer or a doctor that was required he could send a whole carload at $600 apiece!

Mr. Fletcher resumed his seat amid much applause, and was followed by the Rev. T. W. Fyles, of Quebec, who read the following paper:

HOW THE FOREST IN THE DISTRICT OF BEDFORD WAS SWEPT AWAY.

By Rev. Thomas W. Fyles, F.L.S., South Quebec.

The remarks contained in this paper apply to that hilly section of the Eastern Townships which lies between the Seigniories on the one hand and Lake Memphremagog on the other, more particularly to the counties of Missisquoi, Shefford and Brome. I have known the locality for more than thirty years, and, in the early part of that period, was intimate with many of the first settlers of the district. Originally this was one vast forest, broken here and there by lakes and beaver meadows. The prevailing trees were the pine (*Pinus strobus* Lin.), the hemlock (*Abies Canadensis* Michx), the spruce (*Abies nigra* Poir), the balsam (*Abies balsamea* Marshall), the cedar (*Thuja occidentalis* Lin.), the tamarack (*Larix Americana* Michx), the maple (*Acer saccharinum* Wang), the beech (*Fagus ferruginea* Ait), the elm (*Ulmus Americana* Wiild.), the basswood (*Tilia Americana* Lin), the white ash (*Fraxinus Americana* Lin), the brown ash (*Fraxinus sambucifolia* Lin.) the birch (*Betula papyracea* Ait), the butternut (*Juglans cinerea* Lin.), the red cherry (*Cerasus Pennsylvanica* Linn), and the black cherry (*Cerasus serotina* Ehrhart). Some spots were named from the nature of the growth which covered them, as Pine Mountain and Spruce Mountain, in Brome.

In early days the staple productions of the district were pot and pearl ashes; and the tree that was found to yield the greatest abundance of these was the elm, and as in those days the law was administered in Montreal, and was an expensive luxury, the early settlers, many of whom were squatters, were allowed to do in the forest very much that which was right in their own eyes. Accordingly regardless of *meum et tuum*, they cut down the elms wherever they could find them, and converted them into "black salts." Consequently the elms of the primeval forest were the first of its trees to disappear. The pines followed next in order. The quality of the timber and the ease with which it was worked brought the white pine into great request. Where there was water transit, as for instance, near Lakes Champlain and Memphremagog, the clearing off of the pine was rapid. And, throughout the district local requirements could be satisfied only with the choicest timber, and all that was not of the best was accounted "vile and refuse," and was "utterly destroyed." The old court house at Cowansville and the old church at West Shefford, in the soundness and clean grain of the pine lumber employed in them, showed the fastidiousness of their builders' choice of materials.

In the meanwhile, in the struggle for existence, the forest at large was being beaten back; and as Sampson of old said of the Philistines, so the settler might have said of his hacked and dismembered foes, "Heaps upon heaps here they lie!" Blackened piles cumbered the land, to be burned at fitting season, and their remains dragged into new pyres, until, in the language of the people, they were "quite worn out."

The first clearings for actual settlement were made where hardwood timber abounded, for it was well known that hard wood stumps rot out in seven or eight years, whereas the stumps of black timber endure for a lifetime. The trees that were utilized in the havoc were the white ash, the brown ash and the basswood, which were split into fence rails. Now and then a cherry or a bird's-eye maple found its way to the turner's, to be converted into furniture, but too often indiscriminate destruction made room for the corn field and the potato patch. Often when the maples were spared to form a sugar bush, carelessness and ill usage insured speedy decay. I frequently saw trees tapped by the acre with slanting gashes a foot long and two or three inches deep, a proceeding which impaired the circulation of the sap, producing a diseased condition of the tree, which, as we shall presently see, was peculiarly inviting to the attacks of injurious insects. Those were the days when stately specimens of the basswood (the lumber of which would now be worth $20 per thousand) were felled and notched into sections, which were split off and roughly shaped into sap troughs, the larger portion of the wood being wasted in the process.

As the clearings were enlarged and the dairy afforded more employment and greater profits, the traffic in "black salts" died out, and a second period in the history of the district may be said to have been reached. A third and striking era was opened when, by the enterprise of the late Hon. A B. Foster, the railway to Waterloo was completed. Not only did farm produce meet with a readier sale, but a demand for hemlock bark, to supply the southern markets, arose, and men turned their attention more closely to the black timber. The short interval between the hoeing season and hay-time was diligently turned to account in peeling bark—the stripped hemlocks being allowed to lie as they had fallen. In consequence tangled slashes often disfigured the uplands, until a second growth—usually of poplar—hid their deformities.

Hitherto we have considered man's work in stripping the land of its bosky covering, but the elements played no unimportant part towards the same end. Fierce winds from the low-lying "French country," compressed in the valleys and defiles, again and again rushed up the mountain sides, and wherever they found a break formed by new settlements, impinged upon the exposed edges of the forest, and tumbled many goodly trees over, as if some huge monster were rooting amongst them. I know one spot where, for some acres, the trees, after a hurricane, lay in swaths, like grain from the scythe of the mower.

But, if the wind slew its thousands, fire may be said to have slain its ten thousands. The heedless and untimely burning of a brush heap often started a conflagration which extended for miles. One of the first inhabitants of Iron Hill told me that the grandest sight he ever saw was the fire rushing up through the pine woods on the western slope of Brome mountain. In May, 1877, I rode with the late Sheriff Cowan from Cowansville to Philipsburg, and men were pulling down fences and "fighting fire" all along the way. And at Philisburg clouds of smoke, sweeping across Missisquoi bay, told that the fire was raging in the State of New York. Great damage was done to the second growth sugar woods by this conflagration, and for several years after maple wood was *a bon marché*.

In addition to man and the elements, an innumerable yet unobtrusive army of sappers and miners worked upon the forest trees—grubs of beetles and horntails, and caterpillars of moths. I shall speak of but a few kinds that attacked (1) the "black timber," (2) the hard woods, (3) the poplars.

(1) I remember standing in the chancel of a new church which I had built in the township of Brome in 1864, and hearing from the floor a slight rasping sound, I watched attentively, and presently the jaws and head of a Buprestis larva (Fig 5*a* and *c*, the larva and head; *b* pupa, *d* beetle), appeared through a hole. I looked around me and saw that there was a row of holes wherever the flooring rested upon a sleeper, and I found that the sleepers had been made of small spruce and hemlock trees hewn a little on the upper side. These trees were the habitations of Buprestidæ, the larvæ of which, having at this time attained their full growth, had gnawed their way through an inch of floor-lining, and an inch and a quarter of spruce boarding to the upper air, that they might enter upon the pupal condition satisfied that a way of exit had been secured for the coming imagoes.

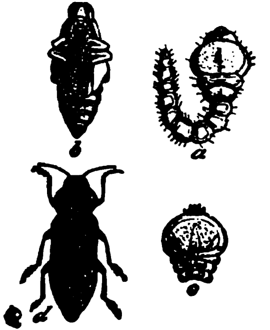

Fig. 5.

There is an insect, a longicorn beetle which, like the "Timberman" of Scotland, finds its food and habitation in the pine. It is *Monohammus Confusor* Kirby (Fig. 6) It is a dark gray, square-hipped insect, an inch and a quarter long, with antennæ of twice that length. This creature often presents itself unexpectedly in strange quarters. One afternoon I was sitting in my study in the rectory at Cowansville, which was then a new building, when suddenly a strange object came down with a great clatter upon the book I was reading. It was *M. confusor*. "Where did you come from?" I said. I looked round and soon discovered a hole recently made in the casing of the door. What an experience that insect had gone through! It had sprung from an egg laid in a crevice of a standing pine. The tree into which it had eaten its way had been cut down, hauled about in the woods, soaked in the mill-pond, and cut up by the circular saw. The boards had been banged about in the piling, had been kiln-dried, and then passed through a planing-machine. That particular board in which the beetle had had its habitation had been worked by hand in "the sash and door factory;" had been planed and fitted, and hammered and painted; and yet—surviving all the rough usage, and escaping all the deadly weapons—there had lain *M. confusor* snugly ensconced in his square-inch, or so, of wood, reserving himself until he could present himself as a gentleman. (Fig. 6.)

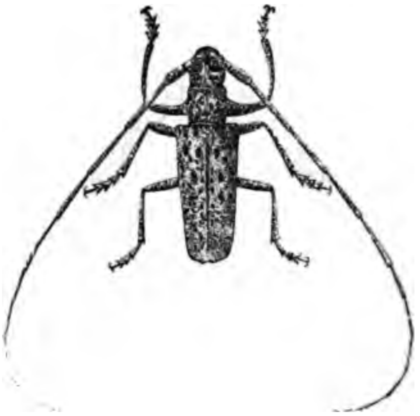

Fig. 6.

Another beetle closely related to *M. confusor*, and of similar habits is *Monohammus marmorator* Kirby. It is somewhat smaller than *M. confusor*, and has shorter antennæ. In color it is brown, marbled with pale yellow.

A third insect belonging to the same genus is *Monohammus scutellatus* Say, (Fig. 7). It is called by the French-Canadians, "*Le Forgeron*"—the Blacksmith. It is deep bistre in hue, and has a white scutellum. During the past season (1895) this insect has been unusually numous and destructive. In the spring one of my neighbors planted an extensive hedge of spruce around his grounds. By the end of summer nearly every scion had been girdled or partially so by the *Forgeron*. The larvæ of the species are even more destructive than the perfect beetles. I have seen a fine, large, spruce tree snap off, two feet from the ground, under pressure from the wind, and, on examination, have found that the stem was tunnelled through and through—scores of the Scutellatus larvæ having mined and countermined it in all directions.

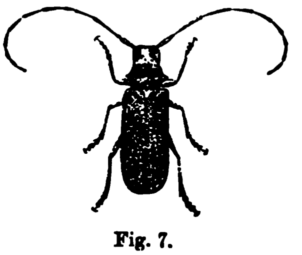

Fig. 7.

) The hardwood also affords food and lodging to various insects. The handsome *Glycobius speciosus* Say (Fig. 8) (whose black and yellow livery is so suggestive of .s and stings, but is *speciosus* notwithstanding) is frequently found in our wood- having arrived at perfection in the maple, the best of our fire-

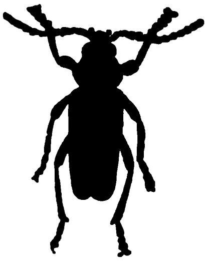

Fig. 8.

But there is a creature that far more extensively assists or npanies the decay of the hardwood trees. It is one of the Horn- , *Tremex columba* Linnæus—an insect belonging to the order enoptera. The female *Tremex* is provided with a strong, k, bristle like ovipositor, which proceeds from the centre of the omen, and, when not in use lies extended beneath and beyond t section in a fixed and protecting sheath. In depositing its eggs creature withdraws the ovipositor from its sheath raises its body d drives the appendage through the bark and into the soft wood, ying its eggs therein. As soon as the young grubs are hatched ey begin to tunnel the wood, enlarging the bore as they increase in size. By the end the first season they attain the dimensions of thread worms. The full grown larva is n inch and a half in length and has a waxen appearance. Its mandibles have a ferru- inous tinge and its spiracles are light brown. The prop-legs are imperfect and the body erminates in a short spine.

Long observation has led me to believe that the Horn-tails and other borers do not attack *sound and healthy trees.* I stated this belief in a lecture I gave in the Somerville course some years ago. Since then I have read the Rev. J. G. Wood's "Insects at Home," and I am glad to find that some remarks of his bear out my statement. Speaking of the dreaded *Scolytus destructor* Olivier of Europe he says :—

"It is much doubted whether the Scolytus ever attacks a healthy tree, principally, as is conjectured because in such trees the burrows of the insects are filled with sap which not only drives out the beetles but prevents their eggs from being hatched. Still when a tree becomes unhealthy the attacks of the Scolytus prevent it from recovering itself," etc.

A tree struck by lightning, or broken by the wind, or scorched by fire, or hacked and abused by man is the chosen object of insect spoilers.

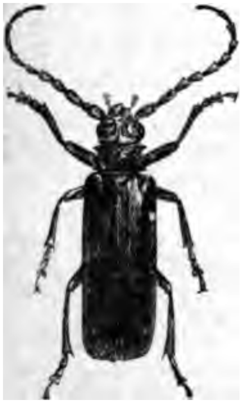

Fig. 9.

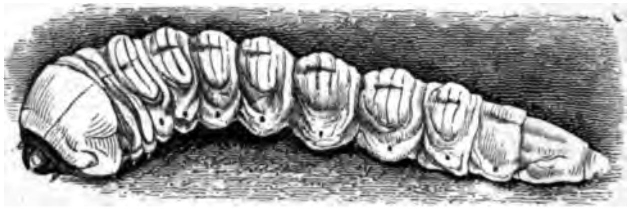

Fig. 10.

I have spoken of the waste of hemlock which followed upon the first demands fo tanbark. Felled hemlock trees that are not soon sent to the sawyer's, are sure to b confiscated by a sawyer of another kind, *Prionus unicolor*, as Harris calls it—the on coloured sawyer—the *Orthosoma brunneum* of Forster. (Fig. 9.) For nature not only abho a vacuum ; she also abhors waste. A standing hemlock in the last stage of its existen produces the *Boletus igniarius* which nourishes the Toad Beetle, *Boletophagus corticola*, Say. A fallen hemlock becomes the food of the Prionus grubs. (Fig. 10.) The creatures are well known to every farmer who has had to clear his land of the half rotten trophies of his early triumphs over the wilderness.

It yet remains for me to say a few words (3) concerning a borer which attacks the poplars, the latest growth on neglected brush lands. The insect is *Cossus centerensis*, Lintner. It belongs to the order lepidoptera. The perfect insect is a large moth with crape-like wings, dark grey in colour, reticulated with fine black lines. It makes its appearance in July. The male is smaller than the female. The presence of the larva is betrayed by the *frass*, or half digested sawdust, which it throws out, in early summer, from its burrow in the tree. On attaining its full size, the caterpillar retires some inches into the tree, and assumes its chrysalis condition. In due time, the chrysalis, by means of a series of serrated rings on its body, works it way along the tunnel bored by the larva, to the surface of the tree, and forces itself through, so as to clear its wing cases. The skin then bursts, and the perfect insect makes its escape.

In bringing this brief history to a conclusion I would bear in mind that the aim of all historians should be to convert the mistakes of the past into lessons for the future; and I would offer a few practical hints :—

I. Believing in the powers of the press, I would commend to all newspaper editors the practice of devoting a column to the discussion of rural affairs. Under a judicious editor the practice is invaluable, for many men in country places read the newspaper, and read little else.

II. In all normal and training schools, teachers should be led to see the importance of training the young in habits of prudence, forethought and economy For want of the exercise of such qualities in his early days many a farmer has now to buy his firewood, or to obtain it from a distance at the expense of much time and labour.

III. I would recommend farmers to thin out their sugar woods, plantations and copses, so that the trees may have ample room to spread their roots and obtain a firm hold on the earth, that they may not easily be overturned by a tempest.

IV. I should say, do not over-prune, and prune in the winter when the sap has ceased to work. Cover all wounds with grafting wax or oil-paint. Neglect of these precautions will throw the trees into a condition which will assuredly invite the attacks of destructive insects.

Lastly, I should say, tap your maple trees with care; use a duck-bill augur and cedar spouts, which "give" and do not split the bark.

A cordial vote of thanks to the Mayor, for his kindness in presiding on the occasion and allowing the use of the city hall for the meeting, was proposed by Mr. Dearness, who spoke very happily of the pleasure and instruction which they had all received from the addresses of the evening, and was seconded by Mr. Saunders, and adopted by the meeting with much applause.

Mr. E. R. Cameron then moved, seconded by Mr. S. H. Craig, a vote of thanks to the speakers who had come from a distance to address them, and had afforded them so much gratification. After putting the motion, the meeting was closed with a few pleasant remarks from the Mayor, who wished the Entomological Society of Ontario a long-continued and prosperous career.

THURSDAY, NOVEMBER 28TH.—MORNING SESSION.

The meeting was called to order at 10 o'clock, a.m., the chair being taken by Mr. Fletcher. The reports of the various sections of the Society were presented and read by their respective secretaries.

REPORT OF THE BOTANICAL SECTION.

The Botanical Section beg to submit the following report for the summer of 1895:

Regular weekly meetings of the section were held from April 22nd to October 19th. The average attendance was considerably in advance of that of the previous year. A number of the public school teachers of the city joined the Society, and became industrious workers in our section. For the benefit of those just beginning the study of botany, a part of each meeting was devoted to the study of some important natural order, illustrated by typical specimens collected by the members.

Papers upon the following subjects were read at different meetings:

1. "The Humanity or Civilization of Plants and Flowers," Prof. J. H. Bowman.
2. "The Relation of Chlorophyll to the Forms of Plants," W. T. McClement.
3. "The Distribution of Plants in Ontario, with Special Reference to the London District," Mr. J. A. Balkwill.
4. "The Dissemination of Seeds," W. T. McClement.

One public field day was held, July 1st, when the members and their friends visited Komoka, and made large and beautiful collections, the feature of the day being the abundance of *Cypripedium spectabile*.

During the season the following plants were added to the local list:

Spergula arvensis—Mr. J. A. Balkwill.

Arctostaphylos Uva-ursi—Prof. J. Dearness.

The section have deemed it wise to direct their attention to the arrangement of a Flora of Middlesex county. A good start has been made toward this, as we have the list of *Polypetalous* and *Gamopetalous Exogens* ready for final revision. We have to thank Mr. Fletcher for a number of rare and interesting plants from the Ottawa district, which he donated to the Herbarium.

W. T. McClement, Secretary.

Mr. Fletcher spoke of the value of the proposed Flora of the County of Middlesex. He also stated that *Spergula arvensis*, which had recently been found in the neighborhood of London, was recommended by the Michigan State Agricultural College for introduction as a fodder plant, but in Europe it was regarded as a persistent and troublesome weed, and was found to bear the same character in some parts of Canada. He strongly deprecated its introduction by farmers into this country.

REPORT OF THE GEOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY FOR THE YEAR 1894-95.

We have much pleasure in reporting to your honorable body that the Geological Section has had a most prosperous year. Our membership has increased; the average attendance at our meetings has been greater than during any previous year.

Many valuable additions have been made to our private collections since last we reported progress, but we are still looking forward to the formation of a central collection in our city, to which the members of our Society and all our citizens may have free access.

The section would suggest that it would be a great advantage to students of mineralogy if some steps could be taken by which the small number of Geological and Natural History societies in the Province could be provided with small collections of accurately named specimens of the chief economic minerals.

The members of our section have made trips to a number of places of geological interest, including Rockwood, Elora, Guelph, North Dorchester, and the mammoth and colossal Caves of Kentucky.

Valuable papers have been read before our section, showing the methods of gold mining in Australia, Colorado, Ecquador and Madoc.

Addresses on the following subjects have been made by various members of our Society:

1 "Trip to St. Joseph's Island." By Mr. MORRIS.
2. "Australian Gold Fields," Mr. WEBB.
3. "Crystallography," Dr. WILSON.
4. "Canoe Cruise on Lake Nipissing," Mr. ALLISON.
5. "Physical Basis of Knowledge," Mr. SCARROW.
6. "Correlation of Forces," Mr. B. GREEN.
7. "Trip to Mammoth Cave," Dr. WOLVERTON.

Signed on behalf of the Geological Section by

G. F. SHERWOOD, Secretary. S. WOOLVERTON, Chairman.

REPORT OF THE MICROSCOPICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

The season opened with the first meeting on October 12th, and continued every second week till March 29th, at which time, as is usual, we discontinued in favour of the Botanical Section, of which nearly all the microscopists are active members.

Regular Meetings.—There have been twelve such. Interest has been well sustained throughout the season, meetings regular, attendance good, subjects excellent and well presented. More than usual the members have engaged in practical work. Among the subjects were: "The Study, Dissection and Mounting of Earthworms," led by Dr. Hotson; "Fungi" (Hymenomycetes), and "Wood Sectioning, Staining and Mounting," led by Prof. Dearness; "Insect Mounting Without Pressure," also "Cell Building," by Mr. Rennie; "Brownian Movement," led by Mr. W. T. McClement; "Fluid Mounting of Green Algæ," also "Collection and Mounting of Diatoms," led by Jas. H. Bowman. Very many microscopical plants were brought in by members and furnished many an enjoyable hour.

Open Meetings —Of these, two were held, and, as usual, attracted a large attendance and were well appreciated by those for whom they were intended. In this connection we would say that we find our present quarters very ill-suited for this class of meeting. Had we held the same in some more convenient place, no doubt a great and favorable difference would be observed.

Outings —These are not so frequent as they might, and would be, if it were not that we occupy only winter months. We have, however, the benefit of the botanists' excursions in the summer time as our members who are botanists are always thinking of our section and preserve their finds and work up their subject in connection with them for our meeting season.

JAS. H. BOWMAN,
Secretary of Section.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

By the Rev. Thomas W. Fyles, F.L.S., Delegate.

I beg to state respectfully that the Society I have the honour to serve on this important occasion, is in a healthy and growing condition—sound financially, possessing a large amount of *materiel*, and held in estimation at home and abroad.

It is to be expected that the subject of economic entomology will commend itself more and more amongst the intelligent members of a fruit growing and agricultural community. The insect enemies of the farmer and gardener are numerous and persevering, and accomplish incalculable harm; and a society that studies the life histories of these foes, and searches for checks upon their efforts, can hardly fail to win adherents and to command support. Accordingly we find that at the thirty-second annual meeting of our Society the council was able to congratulate the members upon "the steady increase in numbers which continued to take place, and the hearty interest that was maintained in the various departments of the Society's work."

The headquarters of the association are in London, the chief town of one of the mo important agricultural and horticultural sections of Ontario, and a fitting centre for a society which is aided by the Ontario Government, and is intended to promulgate practical information amongst the cultivators of the soil, as well as to foster scientific research. The Government grant made to the Society annually is $1,000.

That the Society is doing the work expected from it, and doing it well, may be shewn on sufficient testimony. Thus Mr. L. O. Howard, Chief Entomologist of the Department of Agriculture, Washington, says of it: "The Society has conscientiously complied with the conditions of the grant. Its reports published annually have greatly increased in size, and in the general interest of their contents. They have contained much matter of economic value as well as of educational interest." And the editor of an English magazine speaks of the report last issued as one of more interest to him than all others received from America. Doubtless the Society, with a larger grant, could accomplish more good.

The annual meeting, to which I have referred, was held on the seventh and eighth days of November last. The value of the addresses and of the papers read, and the beauty and rarity of the specimens exhibited on this occasion were fully appreciated by those who were privileged to attend. The President's address was particularly valuable as an instructive sketch, *historical* and *geographical*, of the Society and its work. It was learnt from it that the society has observers and correspondents from east to west throughout this vast Dominion—from St. John, N. B., and Halifax, N. S., to Esquimalt in British Columbia and Masset in Queen Charlotte Islands. A very valuable paper on "The Rhopolocera of the Eastern Provinces of Canada," was read on this occasion by the Rev. Dr. Bethune, editor of the *Canadian Entomologist* It gave a complete list of species and the names of the localities in which each local kind has been taken with—as far as is known—the food plants of the different species.

The titles of the other papers read at the meeting are as follows:—

"Insects Collected in Bermuda During the Winter of 1894," by Gamble Geddes, Toronto.

"Common Names for Butterflies—Shall We Have Them?" by H. H. Lyman, Montreal.

"The Pitcher-Plant Moth," by James Fletcher, Ottawa.

"Catastega aceriella *Clemens*, Semasia signatana *Clemens*," by the Rev. Thomas W.

optera," by W. Hague Harrington, F.R.S.C.

"Food, Feeders, and Fed," by Rev. Thomas W. Fyles, F.L.S., South Quebec.

"An Attack of Ephestia interpunctella," by H. A. Stevenson, London.

"The Economic Value of Parasitism," by F. M. Webster.

"The Re-appearance of Pieris Protodice *Boisd.*," by J. Alston Moffat, London, Ont.

"Remarks on the Structure of the Undeveloped Wings of the Saturniidæ," by J. Alston Moffat.

"Bordeaux Mixture as a Deterrent Against the Flea Beetles," by L. R. Jones, Burlington, Vermont.

"The Gypsy Moth," by James Fletcher, Ottawa.

'The San Jose Scale," by James Fletcher, Ottawa.

"Injurious Fruit Insects of the Year 1894," by James Fletcher, Ottawa.

The twenty-fifth annual report, issued by the Society, contains portraits of Professor William Saunders, F.R.S.C., President of the Society from 1875 to 1886, and Augustus Radcliffe Grote, A.M., one of the Society's honorary members, and it is also illustrated with sixty figures of insects.

Besides the President's address and the papers above-mentioned, the report contains.—

The minutes of the meeting.

The Report of the Librarian and Curator, Mr. J. Alston Moffat.

The Report of the Montreal Branch, presented by Mr. H. H. Lyman, President, and signed by Mr. A. F. Winn, Secretary.

The Report of the Geological Section, presented by Dr. S. Woolverton, Vice-Chairman.

The Report of the Botanical Section, presented by Mr. W. F. McClement, Secretary.

The Report of the Delegate to the Royal Society of Canada.

A very valuable abstract of the proceedings of the sixth annual meeting of the Association of Economic Entomologists, supplied by Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, and Mr. C. L Marlatt, Secretary of the meeting; and a number of interesting notices, critical, biographical, etc.

This report is distributed "not only to our own members, but to every member of the Fruit Growers' Association, to members of Parliament, the Mechanics' Institutes, etc., making an issue of 6,000 copies, (W. H. Harrington, *Canadian Entomologist*, vol. XXVI., p. 2.)

The Society's library now numbers 1,361 volumes—seventy-seven having been added in the course of the year.

Important additions have been made to the Society's collections of insects. In its cabinets may now be seen representatives of 1,077 species duly classified and named.

The Society is fortunate in retaining the services of Mr. J. Alston Moffat as Librarian and Curator. By his methodical habits, his manual skill in mounting specimens, and his extensive knowledge of the lepidoptera, Mr. Moffat is peculiarly fitted for the position he holds.

During the year the various sections of the Society have held field days at St. Mary's, Dorchester, Kilworth, Byron, Komoka, Kettle Point (Lake Huron), Ilderton, Thedford, Beechville, Woodstock, Mud Lake and other places. The value from an educational point of view of such expeditions in a neighborhood that possesses such experienced scientific guides and instructors as Messrs. W. E. Saunders, J. M. Denton, J. A. Balkwill, J. W. Dearness, J. H, Bowman, Dr. S. Wolverton, R. W. Rennie, all long connected with the Society, besides younger and enthusiastic men, is beyond estimation.

The *Canadian Entomologist* has reached its twenty-seventh year. The volume for 4 contains articles from sixty one contributors—fourteen residing in Canada, forty in United States, five in England, one in Germany and one in Sweden. In its pages are cribed no less than seven new genera and ninety-five new species of insects. The gazine continues under the able management of the Rev. C. J. S. Bethune, D.C.L., R S C., etc.; and it is a striking proof of the courage and perseverance of its editor at notwithstanding the cares and anxieties that must have thronged him, through the estruction by fire of his noble school buildings and the beautiful chapel attached to em, the *Canadian Entomologist* has made its appearance as regularly as ever and as arefully edited.

Hitherto the Entomological Society of Ontario has studied the life-histories of insects, the methods of attack of the pests of the homestead, the storehouse, the garden, the orchard, the field and the forest; the ways for circumventing these foes; and the nature and application of insecticides. Much, no doubt, remains to be learned on all these subjects. But the attention of naturalists has of late been drawn to a new and most important matter. It is, to use the heading of one of the papers published in the Society's report that has been mentioned, *The Economic Value of Parasitism.* It is well to know how to meet enemies ourselves, but it is better sometimes to know how to direct faithful allies against them. If the parasite (*Diplosis grassator* Fyles), which keeps down the numbers of the Philloxera in this country, had been carried over to Europe, it would doubtless have saved many a vineyard that has disappeared. The introduction of the Australian Lady-bird (*Vedalia cardinalis* Mulsant), the foe of the "Fluted Scale," has probably saved the orange groves of California from extinction. The predaceous beetle (*Clerus formicarius* Linnæus) has lately been introduced into Western Virginia by Professor Hopkins, as a check upon the "Borers" that have wrought such destruction in the spruce forests of that country. And this bringing about of good by the directing of insect agents is only in its beginning. As our knowledge increases we shall in all probability be able to gather and control forces that at present are but little understood.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year:

President—J. W. DEARNESS, London.

Vice-President—H. H. LYMAN, Montreal.

Secretary—W. E. SAUNDERS, London.

Treasurer—J. A. BALKWILL, London.

Directors—Division 1. JAMES FLETCHER, F L S., F.R.S.C., Ottawa.
" 2. REV. C. J. S. BETHUNE, F.R.S.C., Port Hope.
" 3. GAMBLE GEDDES, Toronto.
" 4. A. H. KILMAN, Ridgeway.
" 5. R. W. RENNIE, London.

Librarian and Curator—J. ALSTON MOFFAT, London.

Editor of the "Canadian Entomologist"—REV. C. J. S. BETHUNE, M.A., D.C.L., Hope.

Editing Committee—J. FLETCHER, Ottawa; H. H. LYMAN, Montreal; REV. T. W. F South Quebec; J. M. DENTON, London.

Delegate to the Royal Society—J. D. EVANS, Trenton.

Committee on Field Days—Dr. WOOLVERTON, MESSRS. SHERWOOD, MCCLEMENT, BAL W. STEVENSON, W. E. SAUNDERS, ANDERSON, ELLIOTT, RENNIE, and Bo London.

Auditors—J. M. DENTON and J. H. BOWMAN, London.

FIELD DAYS.

A discussion on Field Days and the best methods of conducting them was participated in by most of the members present. Mr. Fletcher described the plan adopted by the Field Naturalists' Club of Ottawa, which had proved very successful. It was decided that every effort should be made next summer to develope the system and that the annual meeting of the Society should, if possible, be held in August in order to have a general outing for the members in connection with it.

THE CANADIAN ENTOMOLOGIST.

A discussion was next carried on by Messrs. Balkwill, Rennie, Dearness, and Fletcher as to the possibility of reducing the expense incurred in the publication of the *Canadian Entomologist*. The treasurer and editor were instructed to confer with the publishers on the subject. Mr. Dearness suggested that a leaflet should be printed for enclosure in correspondence, setting forth the advantages of membership in the Society.

AFTERNOON SESSION.

The meeting was called to order by the President, Mr. J. W. Dearness, at 3 o'clock, p.m.

Papers were presented by Mr. Moffat on "Observations on the Season of 1895," "Variation, with Special Reference to Insects," and "The Growth of the Wings of a Luna Moth."

Mr. Fletcher gave an interesting address on his trip to British Columbia during the past summer, which was undertaken for the purpose of collecting and observing insects and plants throughout the region traversed. He illustrated his remarks by exhibiting a beautiful collection of dried plants that he had made, and several boxes of rare and remarkable insects.

A fine specimen of the exceedingly rare elater, *Sarpedon scabrosus*, was exhibited by Mr. J. D. Evans, who had taken it during the past summer at Trenton, Ont.

The receipt of valuable donations to the Society's collection of insects was announced from the Rev. G. W. Taylor, Nanaimo, B.C, Mr. E Firmstone Heath, the Hermitage, Cartwright, Manitoba, and C. de Blois Green, Osoyoos, B.C., and the hearty thanks of the Society were accorded to the donors. Dr. Bethune stated that arrangements had been made for the exchange of publications from the year 1868 with the Entomological Society of France, whose "Annals" would form a very important and valuable addition to the library.

Much time was very enjoyably spent by the members during both the days of meeting in exhibiting rare captures, examining the cabinets and books of the Society, and comparing notes on many interesting entomological subjects.

INSECT INJURIES OF THE YEAR 1895.

By JAMES FLETCHER, OTTAWA.

The insect injuries to the crops of the province during the past season have been almost entirely by well known pests.

Cereals.—Grain crops have suffered very little; the most serious injuries were by "grasshoppers." These developed in large numbers all through those districts where drought prevailed, and did much harm to grass, oats and barley. The species which were most abundant were *Melanoplus femur-rubrum*, *M. atlanis* and *M. bivittatus*. Outworms (Fig. 11) were less complained of than usual, taking the province as a whole. *Hadena arctica* and *Hadena devastatrix* occurred abundantly in the extreme western counties. Hessian fly was sent in from the Muskoka district; and also the joint worm (*Isosoma hordei*), Fig. 12, the latter attacking wheat and injuring it to the extent of five per cent. at Meaford, Ont.

Fig. 11.

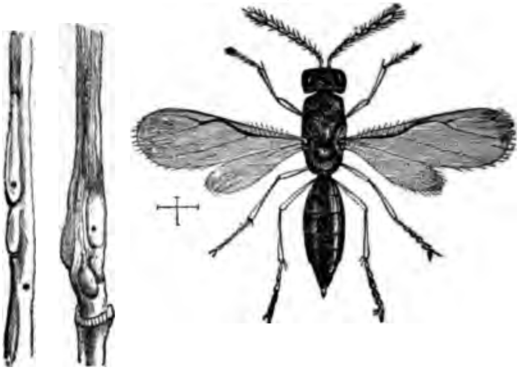

Fig. 12.

Fodder Plants.—Under this head, undoubtedly the greatest damage was done by grasshoppers, and farmers will do well next season to examine their grass lands early in the season before the grass is too high, to see if there are many of the young, and if so, to use one of the different "hopper-dozers" or oil pans which are used to such good effect in the Western States. The Pea Moth has continued its injuries, and up to the present no practical remedy has been discovered. I commend this insect to the particular attention of our members. Although known as so abundant and injurious for the past twenty years, the perfect insect in this country has never yet been identified.

Roots.—The Colorado Potato-beetle still exists in great numbers, but with so cheap and effective a remedy as Paris green, it cannot be considered a serious enemy except by the lazy or careless. The larva of *Gortyna cataphracta* was sent in from three or four places in Eastern Ontario as having bored into the stalks of potatoes, tomatoes and many other garden plants. A new attack on potatoes reported this year for the first time was by *Otiorhynchus ovatus*, which was sent from Fenella, Ont., by Mr. J. B. Brook, who had found it girdling the stems of his potatoes. The same insect was found injuring young apples, pears and currants at Arthabaskaville, Que. Turnips were badly attacked all over the province by the Turnip Aphis, and many reports were received. There is no very satisfactory remedy for this insect. Careful watch should be kept in August when hoeing and thinning turnips At that time the colonies are small and few in number, and if care be taken to destroy them then, much may be done to control the outbreak. Spraying with kerosene emulsion was found to be useful when the colonies were not too numerous. A tobacco and soap wash would be equally effective. The Diamond-back Moth (*Plutella cruciferarum*) was also abundant both on turnips and cabbages, but affected the crop very little. Cabbage and Onion Root-maggots were as usual abundant in many places, and did much harm. The Imported White Cabbage Butterfly (*Pieris rapæ*), Fig. 13, is not now considered a very serious enemy where the use of pyrethrum powder and flour (one to four) is practised. The best way to apply the remedy is to dust it over the cabbages as soon as the work of the larvæ is noticed, by means of small hand bellows or from a muslin bag. It cannot be too strongly insisted upon that Paris green must never be used on cabbages.

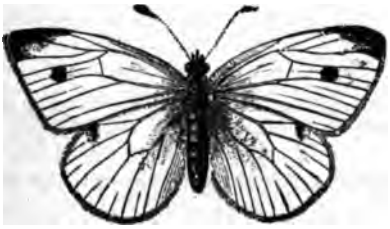

Fig. 13.

Fruits.—The injuries to fruits cannot be said, as compared with other years, to have been very serious. Most of the usual pests have put in an appearance and done some harm, but the more general adoption of the excellent practice of spraying regularly is having a noticeable effect. Codling moth, Plum curculio, Canker-worm, Eye-spotted Bud-moth, Tent caterpillars and Fall Web-worm have been abundant in some places, but their numbers have been brought down considerably wherever spraying with the arsenites was resorted to.

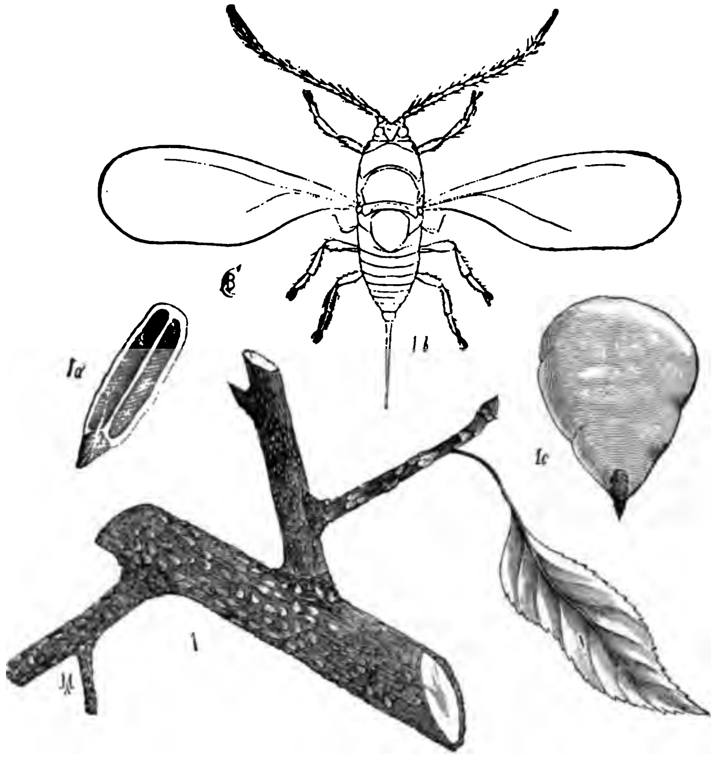

Fig. 14.—1, twig with scales; 1*a*, scale of male; 1*b*, winged male; 1*c*, scale of female—highly magnified.

The Oyster-Shell Bark-louse is abundant throughout the province, and where orchards are neglected does much harm. Spraying with kerosene emulsion when the young insects emerge from the old scales, about 1st June, is the best remedy. The Scurfy Bark-louse, *Chionaspis furfurus*, Fig. 14, was sent from Essex County. One tree was badly infested, but a thorough spraying with kerosene emulsion entirely cleaned it.

The New York Plum-scale (*Lecanium*) has been found, on enquiry, to be present to some extent all through the Niagara peninsula and in some other western counties. Only two bad occurrences have been discovered, and I am much pleased to be able to report that these have both been eradicated by treatment with kerosene emulsion. The life-history of this scale is quite different from that of the Oyster-Shell Bark-louse. In this species, the young emerge at the end of June and make their way out on to the foliage, where they remain without growing much until autumn; they then crawl back again on to the twigs and branches and hibernate there. When revived by the return of spring, they move again and fix themselves to the young wood, chiefly on the lower side of the smaller branches. They grow very rapidly in spring, and the tiny flat scales which hibernated, soon become large, conspicuous, dark brown, hemispherical scales, varying somewhat in size, but about one-eighth to one-sixth of an inch in length by about half of that length in height. The basal outline is ovate or almost round, being very nearly as wide as long. This insect has been carefully studied by Mr. Slingerland, of Cornell University, and the remedy which he suggested has been used very satisfactorily both at Queenston and Grimsby, where the two serious outbreaks referred to above occurred.

This treatment is to spray infested trees at least twice during the winter with a strong kerosene emulsion wash—the Riley-Hubbard emulsion diluted with only four parts of water. This did no harm to the plum trees, but quite destroyed the scales.

Canker-worms (*Anisopteryx*). There has been a good deal of enquiry during the past season as to the best way to treat Canker-worms in orchards There can be no doubt about the superiority of spraying with Paris-green over all other methods, where the trees are small enough to be reached easily with an ordinary spraying nozzle; but where trees are old and large, some growers still prefer to use the old method of banding the trunks of the trees with printers' ink and oil or some other viscid material. Mr. O. T. Springer, of Burlington, Ont., uses a mixture consisting of castor oil, two pounds and resin, three pounds, heated and thoroughly mixed. This is painted directly on the tree trunks in autumn and spring. In Nova Scotia, printers' ink is reduced with fish oil, and this is painted on strips of thick paper which have been previously tacked round the trunks. Mr. E. J. Armstrong, of Church Street, Cornwallis, in the Annapolis valley, informed me, when enquiring why he preferred banding to spraying, that the chief reasons were that the trees in Nova Scotia were large, and it was the practice to grow other crops in the orchards, and, besides, injury had been done by careless spraying. He gives the cost of this treatment about as follows: Printers' ink is about twelve cents a pound; twenty pounds of ink will require four gallons of fish oil, at fifty cents a gallon. This amount will answer for an orchard of five acres, the trees being of about twenty or thirty years. It will require about fifteen pounds of paper, at four cents a pound. This is cut with a saw from the roll in strips six inches in width. Two men, armed with a sharp knife and a tack hammer, can go over an orchard of five acres in half a day, the first man measuring the tree and cutting off sufficient paper to band it, the second one tacking it on. The ink is applied in autumn and spring with a paint brush, and the paper put on in autumn is ready for the next spring.

The Cigar Case-bearer (*Coleophora Fletcherella*), which has done so much harm to apples in Ontario and Nova Scotia during the past four or five years, and of which I spoke last year, has been the cause of much loss again this year. Spraying with kerosene emulsion, directly the young caterpillars begin to move out on to the buds in spring and spraying regularly two or three times at short intervals of four or five days with Paris green, one pound to 200 gallons, have both been attended with a measure of success; but this is an exceedingly difficult insect to destroy, owing to the fact that the caterpillar feeds mostly on the inside tissues of the leaf, merely eating a small hole through the outside skin so as to get at the inner tissues, which it mines out in a large blotch mine as far as it can extend its body from its case. Mr. Edwin Worden, of Oshawa, has, during the past summer, sprayed his trees with a Paris green and lye wash, which he writes me has been most satisfactory. The first time he used this remedy he sprayed with concentrated lye only. This was about the middle of May, 1894, and Mr. Worden was under the impression that the application had not killed many of the Case-bearers; but the effect was very beneficial, and he could see distinctly where the spraying had been done by the cleanness of the trees from moss and Oyster-Shell Bark-louse. Last summer he sprayed again with three cans of concentrated lye and one quarter pound Paris green in forty-five gallons of water, and secured the best of results; he particularly states that the lye did not injure the foliage at all. This spraying was done in the beginning of June, and Mr. Worden's object was to destroy at the same time the Codling Moth, the Cigar Case-bearer and the Oyster-Shell Bark-louse. No doubt many other pests would be killed at the same time, such as the Canker-worm, Eye-spotted Bud-moth, Leaf Rollers, etc.

The Peach Bark-borer (*Phlœotribus liminaris*) which has for some years done so much harm in the peach orchards of the Niagara Peninsula, has this year been successfully treated by Mr. O. E. Fisher, of Queenston. Noticing that the perfect beetles became active very early in the spring, he washed his trees then with a strong alkaline wash to which carbolic acid had been added. He made his wash as follows: Five pounds of washing soda, three quarts of soft soap, and enough water to make six gallons. Air-slaked lime was then added sufficient to make it of the consistency of thick paint. To all this was added three tablespoonfuls of Paris green and one ounce of carbolic acid.

ture was applied with a whitewash brush, thoroughly covering the entire trunk ee and a few inches up on the limbs. Mr. Fisher reports that at the end of the e is quite satisfied with the results of the treatment. It would appear from ave just said that two applications of this mixture, the first one being made as he beetles become active, sometimes as early as March, and another six weeks uld provide us with an effective remedy for this little pest, which for some years considerable harm in our Canadian peach orchards.

:k Peach Aphis (*Aphis persicæ-niger*).—The only new fruit pest of any importance s appeared in the province during the past season is the Black Peach Aphis, of ecimens have been sent in from two orchards at Leamington, in Essex county. ct has undoubtedly been imported from the United States on young nursery There are two forms of this insect, one attacking the twigs, the other, more in- nd much more difficult to treat, occurring on the roots. Prof. John B. Smith, of inswick, N. J., who has studied this Aphis a great deal, states that the form on is easily controlled with kerosene emulsion; and the underground form he has lly treated with heavy top dressings of kainit. He recommends for light soils Jersey about ten pounds per tree, covering the probable extent of the root system, or a bearing tree from four to six inches in diameter, and the time for applying t is in the spring, when the trees are leafing out. Prof. Smith states that "the s proved successful in our orchards, wherever used." Another method of treat- ich has been recommended is to dig in tobacco waste around the roots.

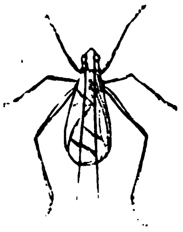

Fig. 15.

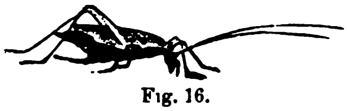

Fig. 16.

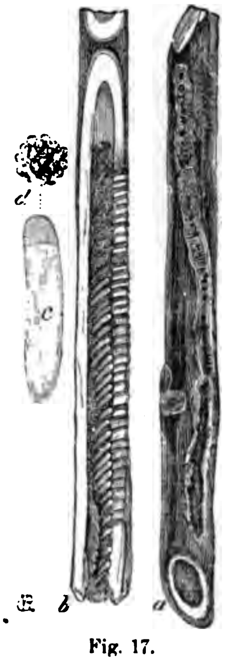

Fig. 17.

Fig. 15, male; 16, female; 17, injured canes.

Woolverton, the energetic Secretary of our sister society, the Fruit Growers' ion of Ontario, states that the Pear Leaf Blister Mite (*Phytoptus pyri*) is rapidly ground in the Niagara district, the corky dark-colored galls being conspicuous on ge of most pear trees. On account of the diminutive size of the mite which causes ster-like galls and from the fact that it works inside them out of sight, it is seldom ed as the cause of the injury, many people attributing the origin of the galls to some parasitic fungus. The treatment which has been recommended for this pest is spra ing the trees with kerosene emulsion just as the buds burst in spring. On the Pacif Coast, where it is also very prevalent, good results have been obtained with a wint wash consisting of sulphur one pound, lime two pounds, salt one pound, and water thr gallons. The manufacture of this wash is described in detail in an article on the Sa Jose Scale published in our last annual report.

The Snowy Tree-Cricket (*Œcanthus niveus*), or one of the allied species, is doing mu harm in raspberry plantations about Hamilton. Several specimens of injured canes ha been sent to me which had been pierced by the females when depositing their eggs. Son of these had split open down the whole length of the punctured area, and the canes in a cases were much weakened. This insect is claimed to be predaceous, and Miss Mar Murtfeldt, who I think was the first to observe this fact, says that they feed almost entire upon Aphides and other minute pests and make ample compensation for all the injury th they do, and that they should be considered beneficial rather than injurious. Arour Hamilton, however, I am told by Mr. Wm. McEvoy, of Woodburn, Ont., that the injuri to raspberry canes are serious. The only remedy which seems practicable is the pruni and burning of the injured canes early in spring before the eggs hatch, for the insect pass the winter in the egg state inside the canes. Figs. 15, 16 and 17.

The insects I have mentioned I think will include all the worst enemies which ha been brought before my notice during the season as having occurred injuriously in t province. There were, of course, several others, but none requiring special mention, exce perhaps, the Carpet Beetle (*Anthrenus scrophulariæ*), Fig. 18, which is gradually extendi its range, and the Mediterranean Flour Moth (*Ephestia Kühniella*), Fig. 19, for which new locality has been found at Valleyfield, Que. Specimens were sent to me from a mi early in October, and instructions were promptly given as to the best steps to take t clean the mill. These were adopted, and in December I received a report from the manage that the outbreak had been suppressed. I think it probable that he may have taken to favourable a view of the matter, and I have urged upon him the necessity of keeping constant watch for any appearance of the insect. This is not only an extremely injuriou pest, but an exceedingly difficult one to eradicate. I find that it occurs more or les plentifully in some of our large milling centres, and, where special efforts are not put fort to control it, loss is sustained.

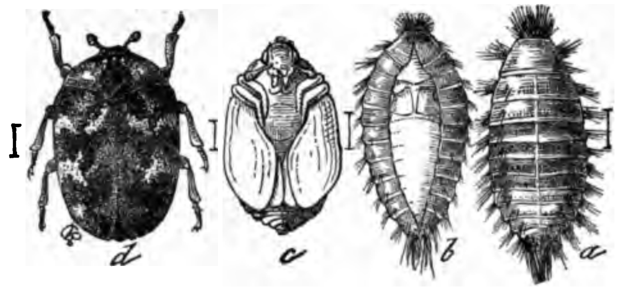

Fig. 18.

Fig. 18, *a* and *b*, larva; *c*, pupa; *d*, beetle.

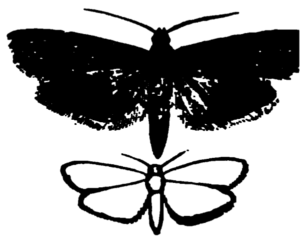

Fig. 19.

(a). Moth (imago) magnified.

(b). Outline, showing natural size.

THE GROWTH OF THE WINGS OF A LUNA MOTH.

By J. A. Moffat, London, Ont.

In the afternoon of March 5th, 1895, I heard a noise amongst my cocoons. O examination I found that it proceeded from the cocoon of an *Actias Luna*, Fig. 20, whi had been given to me early in the season. It was extremely thin; when I took it up could see the movements of the imago through it. It was revolving as well as scratchi vigorously. It seemed to be conscious of its imprisonment, and appeared so eager to escape, it made me feel uncomfortable, so I opened a hole in the cocoon, out of which it crawled on to a finger which I extended for its convenience, thus missing an opportunity of seeing it dig its own way out. It was perfectly dry, and left no moisture on the cocoon or pupa case. I gave it a position to suspend from, where I could observe it conveniently. I looked at the time; it was a quarter to three. It did not show the slightest inclination to travel.

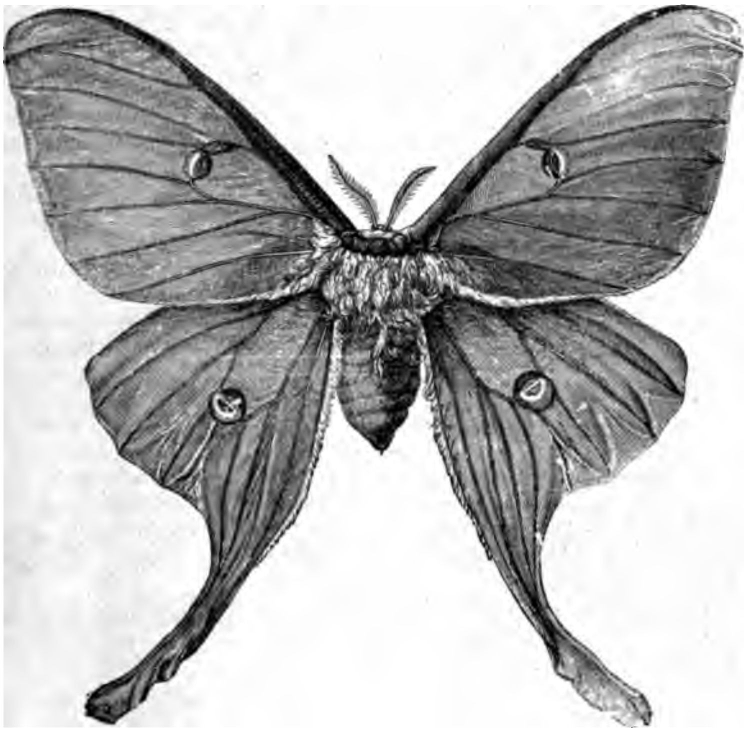

Fig. 20.

The abdomen was fully extended, green in colour with, comparatively, narrow white bands around it. The front winglets were about three-quarters of an inch in length, the hind ones less, clothed with hair-like scales, slightly tinged with yellow, sufficient to contrast with the pure white of the body covering. The tail was bent round and laid along the outer angle of the hind winglet, as shown by part *b* on Fig. 21, which gives a moderately correct representation of it on an enlarged scale. At five minutes to three a green spot appeared near the base of front winglet, gradually enlarging as the fluid spread between the membranes, and deepening in colour as the quantity increased. At three o'clock the green had reached the eye-spot on the front wing, and the maroon colour of the costal band. At 3.10 the wing was one inch and a half long. By this time the fluid was passing rapidly along the costal edge and extending, whilst the outer angle had not yet begun to extend; the result was the apex drawn back, the membrane of the wing bulged and bagged outward. At this time the hind wing had got a green tinge along the outer margin, which was extending. At 3.20 the outer angle of front wing had relaxed somewhat, which allowed the costa to straighten and reduced the bulging. 3.35—the front wing looked to be full length, but not full width. 3.45—hind wing well expanded and green coloured; part *b* on Fig. 21 had moved away slightly from part *a*.

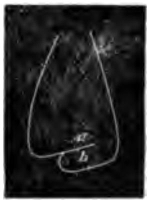

Fig. 21.

At four o'clock the space between *a* and *b* was nearly half an inch, but *b* yet retai horizontal attitude. At 4.10 the space between them had increased, and the po part *b* was drooping. 4.45—the tail had greatly extended, hanging crumpled twisted. At 5.10 the moth opened its wings and walked away when I ceased t observations. I allowed it to live over night. It was a female, not a first specimen. It measures four and a half inches in expanse of wing, and three quarter from the base of the antennæ to the end of the tail. It is heavily edged maroon on the outer angle of front wing, and more lightly on the hind wing and curve of the tail. There is a row of brown dots on the veins of front wings, eighths of an inch from the coloured edge, which are not seen on any other specimen in the collection. As it matured the abdomen contracted until the white united, and the green disappeared.

OBSERVATIONS ON THE SEASON OF 1895.

By J. Alston Moffat, London, Ont.

Hadena Arctica, Fig. 22, one of the climbing cut worms, the moth of which i to some extent every season, and in some seasons quite plentifully, appeared i early part of June in extraordinary profusion, forcing itself on the attention of the unobservant, and continued for over four weeks to be a complete nuisance to the munity. It was to be seen everywhere; shop windows were rendered unsight their presence, dead and alive. They would enter dwellings, hiding away for th in the folds of curtains and clothing, alarming the owners needlessly about their s and making themselves generally obnoxious in a hundred ways. I received inq concerning them from various directions, which went to prove conclusively that thi of things existed from the Niagara river on the east to the Detroit river on the and from the north shore of Lake Erie to the south shore of Lake Huron. How much further they extended I have not learned.

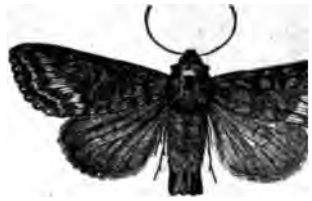

Fig. 22.

The Genus Argynnis, in some of its species, is to be seen more or less abundantly every season. But 1895 gave them forth in numbers both of species and specimens beyond all that I have ever seen before. During July there were five species on the wing at the same time. *Cybele*, *Aphrodite*, *Atlantis*, *Myrina*, and *Bellona*. Upon large patches of flowering weeds that were attractive to them they congregated in force, and when disturbed, they would rise in such a mass as to obscu view beyond. It was my first experience with *Atlantis*. On the twenty-seve June I was in a locality where Argynnis was flying profusely. *Cybele* and *Aph* were abundant, but there were some that seemed to be different from either, and which I was not familiar. They were smaller in size and with a noticeable black on the hind wings, so I captured some for comparison. All the *Atlantis* in the So collection are labelled "Montreal," and are quite uniform in size and markings. were none of those I took that were quite so small, or with so much black in the b On the first of July I secured more, and found that they varied considerably. So them I could not say whether they were small *Cybele* or large *Atlantis*, so to sett doubt, I sent an example to Mr. W. H. Edwards, who promptly informed me that i *Atlantis*. I saw them plentiful at Sarnia, and Mr. W. E. Macpherson, of Prescott, said it was the same at Windsor. On the sixth of August I received several spec from Mr. Macpherson, taken by him at Prescott. They were much nearer to the Q type than the majority of those I took here; with a little additional black in the of the hind wings, they might not be separable. I may state here as a matter of interest that I never took at Hamilton what I consider to be typical *Aphrodite*, wit dark cinnamon-brown shade on the under surface of the hind wings, which is con tively common about London, and easily obtained.

On the twelfth of August I had a call from Mr. Wm. Lochhead, of Napanee, Ont., on his way east from a visit to Windsor. When we were looking at a drawer of North American specimens that are labelled "Non-Canadian," his eye resting on *Argynnis Idalia*, he remarked: "There is a butterfly that was taken at Windsor." I had long desired to hear of that species being reported Canadian. I expected it to enter our territory in the east, but instead it has come to us in the west. Afterwards I received through the kindness of W. S. Cody, B.A., a Windsor specimen for the Society's native collection.

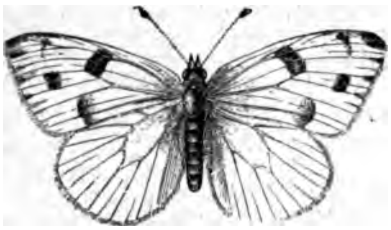
Fig. 23, Male.

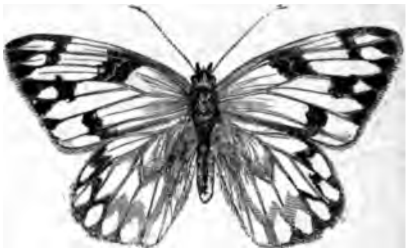
Fig. 24, Female.

Pieris protodice has been seen here in greater numbers this season that it was last. It has also been reported to me from other localities. Mr. Macpherson, who spent some weeks collecting about Windsor, Ont., called upon me when he was returning east. Whilst looking over the Society's collection, when we came to the *Pieris* he pointed to the female of *Protodice*, remarking, "There is the butterfly I saw at Windsor and didn't know what it was!" An interesting testimony to its total absence of late years, which seems so strange to those to whom it was such a familiar object in times gone by. I received a letter from W. S. Cody, B.A., of Windsor, dated July 22nd, in which he said, "*Pieris protodice* appeared for the first time here about the 4th of July, although it might have been here unnoticed before that, and soon became more common than *P. rapæ*. Not being familiar with it, I took nothing but females for a while, and think they must have been more common than the males at first." We can easily understand how male *protodice* might pass unnoticed when flying with *rapæ*, Fig. 25. Mr. Anderson took males only here during July; he did not even see a female. It has also been reported to me as being plentiful at Essex, Alvinston and Woodstock.

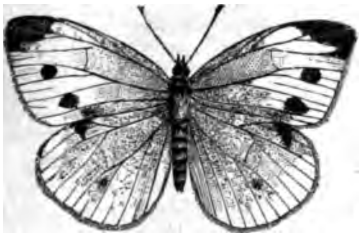
Fig. 25.

In 1895 the season for collecting commenced early, but received a check later on. Mr. Anderson reported to me some good finds at electric light before I thought it likely that anything could have been got, light proving more profitable with him than bait throughout the season. The fascinating power of light at night seems to be general over all kinds of insects, and by concentrating it at particular points makes it easy to secure quantities of them, and gives an opportunity of estimating the comparative scarcity or abundance of the various kinds better than any other method. In this way, Mr. Anderson could have taken dozens of some kinds that I thought I was doing well to get two or three of in a season in the ordinary way of collecting. Bait will not attract some, no matter how skilfully it is compounded, and it fails with all at times; but light, especially electric light, never fails to draw, if the weather is at all propitious.

In September, I sent to Prof. J. B. Smith a box containing twenty-nine specimens of Mr. Anderson's securing, which I could not identify with anything in the Society's collection. Fourteen of these proved not to be represented therein. I had sent a few Bombycids which the Professor did not care to pronounce upon in the present transitionary state of the nomenclature. There were some duplicates, different looking forms of one species, whilst others were varieties or better and more distinctly marked specimens of those already named in the collection. As a testimony to the character of Mr. Anderson's work, I quote from Prof. Smith's letter to me accompanying the list of names: "Your box of insects came duly to hand by express, and in good condition. It is by all odds the most interesting box you ever sent me, and contains the best species, as well as, I think, the best specimens I have ever had from you. * * * Your Nos. 2 and 5 (*Copipanolis cubilis*, Grote) are varieties of one thing, and, if you have others, I would very much like to have a specimen, since the species is not represented in my cabinet. No. 3 (*Feralia major*, Smith) is a very good species, recorded, I believe, for the first time from Canada in this sending. Your No. 11 (*Dicopis Grotei*, Morr,) is a beauty, and perhaps the handsomest specimen of the species that I have ever seen. No. 10 (*Xylomiges dolosa*, Grote) is by no means common. The other species need no special reference and are noticeable only by their excellent condition."

Amongst the Bombycids that I sent to Prof. Smith was a Gastropacha, which he gave as "*Ferruginea*, probably." This I expected would likely be so, as it corresponded well with the original description in everything except size. Packard says, Pro. Ent. Soc. Phil. Vol. III., p. 386, "A smaller species than *G. Americana*." But all the specimens that I have seen of this form are decidedly larger. In the "Preliminary Revision of the Bombyces of America North of Mexico," by Neumœgen and Dyar, *Ferruginea* is given as a variety of *Americana*. During the early part of May, *Americana* was abundant at light. This *Ferruginea* did not appear until the middle of June, and not so numerously, and the one had passed before the other appeared, which seems to conflict somewhat with the idea of their being forms of one species.

The other names of this lot that were new to the Society's collection are:

Acronycta hasta, Grote. Resembling *lobeliæ*, but smaller and darker.

Dicopis viridescens, Walk. A widely distributed species.

Mamestra detracta, Walk. The habitat of this species is given in Prof. Smith's List as Labrador, White Mountains, Colorado, 12,000 feet.

Xylophasia lateritia, Hubn. A European as well as American species.

Perigea luxa, Grote.

Scopelosoma devia, Grote. This addition completes the list of this genus in the collection.

Morrisonia evicta, Grote.

Hyblæa puera, Cram. Prof. Smith, in his catalogue, bibliographical and synonymical, gives the habitat of this species as Texas, Florida, West Indies; and remarks, "It seems to be a common form in more tropical regions and only occasional in our own fauna."

Melipotis jucunda, Hubn. This is but the second species of the genus to be represented in the Society's collection. *Limbolaris* was frequently taken about Hamilton. I am not aware of this species being reported from Canada before. The other species of this genus are all given as from the south and west.

I afterward sent a box of Bombycids to Mr. Harrison G. Dyar, who kindly determined them for me. Those of them that were new to the Society's collection of Mr. Anderson's captures are:

Lophodonta georgica, H. S.

Schizura leptinoides, Grote.

Ianassa lignicolor, Walk.

Cerura scolopendrina, Bdv. Upon this species Mr. Dyar remarks, "The specimen is of the form *Modesta*, Hud., the band broken as in *Albicoma*, Strecker." These names are varieties of *Scolopendrina*.

Mr. Anderson also secured two specimens of *Dilophonota ello*, Linn, in splendid condition; and a pair of *Protoparce cingulata*, Fab., with the pink ornamentation beautifully bright and fresh.

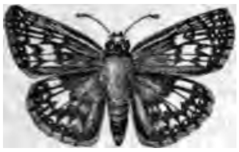

Fig. 26.

A rare and interesting capture by Mr. Anderson in the early part of October was a specimen of *Pyrgus tessellata*, Scudder, Fig. 26, fresh and in fine condition. It was in company with another, which he did not secure. This attractive butterfly has been reported once before from Ontario, taken by Mr. Lowe, in Essex County, and given under the synonym of *Hesperia oileus*, Humph.-West, June, 1875.

VARIATION, WITH SPECIAL REFERENCE TO INSECTS

By J. Alston Moffat, London, Ont.

> " No compound of this earthly ball
> Is like another, all in all."—Tennyson.

Variation amongst forms of life is one of the most interesting and evident truths in nature. The causes at work producing it are receiving a marked degree of attention at the present time, but not more than the importance of the subject deserves. No one has given thought and attention to its manifestation amongst living forms without being subjected to difficulty and perplexity by it. It lies right across the path of the investigator of the laws of life, and is the stumbling-block of the systematist. It cannot be ignored or thrown aside, but must be admitted, and a place given to it in every system in nature that is constructed.

The causes of variation in forms of life are many. Some of them are simple, apparent and easily comprehended. Others are obscure and difficult to trace. As a considerable diversity of opinion exists as to the source of its origin in nature, and the present state of our knowledge does not satisfactorily explain all that we see associated with it, therefore, an orderly statement in plain language of what is known on the subject may not prove objectionable to those who have got into perplexity and wish to investigate the subject for themselves.

All nature—that is, everything that comes within the range of physical investigation—is controlled by unchanging law. Each portion of it has a law or laws of its own, which we call the laws of its nature. We do not see these laws; we know of their existence only by observing the uniformity of their manifestations. For instance, given the same materials in the same proportions and in the same conditions, and the same results will follow every time. Change one of these by ever so little, and a different result will certainly be produced. Thus we have the ever-changing manifestations of nature from unchanging laws, through the ever-changing conditions and combinations of the same materials. Life is as completely under the control of law as matter, but it is infinitely more complex and difficult to trace.

Matter has been divided into the organic and inorganic. The inorganic surface of the globe is the foundation on which rest the organic forms thereof, and from which they may be said to have come, as all the materials for their solid structures and sustenance are derived therefrom. The face of this globe has been frequently changed. There was a time when life could not exist upon it. When the conditions became favorable, organisms appeared suitable for the conditions—low in the scale of life, but neither defective nor degraded. That forms of life varied with the varying conditions of the earth's surface, is conclusively demonstrated by the geological record, and that the organisms of the various geological periods were as thoroughly in harmony with the conditions in which they lived as are those of the present. That many of the forms of life in the present are the lineal descendants of some of those of previous geological periods is extremely probable, if not positively certain, but so changed in appearance by altered conditions as not to be now recognizable.

No doubt many forms of life came and went before insects appeared. These ar comparatively highly organized forms of life, the higher appearing later in point c time, life keeping pace with its surroundings, and so maintaining harmony. Th conditions are not uniform over all the earth's surface at the present time, and w know that the appearance of the life of the various portions of the globe differs i many instances to such an extent that an expert can tell from what part of the worl a particular form came by its appearance; and thus we learn that variation in livin forms is not a thing of recent origin.

Our knowledge of the extent to which variation may go is largely obtained fro man's efforts to change for his own advantage those kinds which he thought wer going to prove conducive to his welfare or gratifying to his fancy. But man's method in bringing it about are not identical with nature's. Although they must be in ha mony with the laws of nature for profitable results, yet illustrations taken from on and applied to the other may be very misleading.

Wallace, in his "Island Life," page 55, says: "Few persons consider how largel and universally all animals are varying. We know, however, that in every generatio if we could examine all the individuals of any common species, we should find co siderable differences, not only in size and colour, but in the form and proportions c all the parts and organs of the body. In our domesticated animals we know this t be the case, and it is by means of the continual selection of such slight varieties t breed from that all our extremely different domestic breeds have been produced. Thin of the difference in every limb and every bone and muscle, and probably in every par internal and external, of the whole body between a greyhound and a bull-dog! Y if we had the whole series of ancestors of these two breeds before us, we shoul probably find that in no one generation was there a greater difference than now occurs i the same breed, or sometimes even the same litter. It is often thought, however, th wild species do not vary sufficiently to bring about any such change as this in th same time; and though naturalists are well aware that this is a mistake, it is onl recently that they are able to adduce positive proof of their opinions."

In this extract we get great truths clearly stated, with a misleading inferenc appended. No divergence has ever appeared in the dog family in nature at all con parable to that between a greyhound and a bull-dog, and I have no hesitation i saying never would, no matter what length of time was given, and so long as the do remained in a state of nature, we might add never could, and the reason is simp and obvious. All man's domestic animals came originally from wild forms; all th possibilities that man has disclosed were latent therein. Under domestication the became apparent, then by selection, elimination and rejection, man led one strain i this direction and another in that, concentrating and exaggerating these points difference until the present results have been reached. Now, selection in nature is the most indiscriminate character possible. There is a constant commingling of t slightly divergent forms going on that never gives any peculiarity an opportunity concentrate and disclose itself very conspicuously, and if it did in one instance would be reduced or even obliterated, to all appearance, in the next generation. A it is this sort of selection that produces and maintains that marked degree of gene uniformity which we see does prevail amongst living forms in a state of nature. Th we learn how widely divergent is the result of selection in nature from selection man for his own benefit, the one tending to reduce variation to a minimum, the oth to carry it onward to its maximum.

The most powerful influence for the producing of variation in life in nature, is to found in external conditions. A power inherent in a locality, capable of modifying t appearance of an organism residing therein, combined with the susceptibility in varyi degrees of the organism to receive, retain and transmit the impressions. That livi forms are changed in appearance by residence in different parts of the globe is a fact requiring to be proved in the present day. It has forced itself upon the attention of observing travellers, and the books of such travellers as Darwin and Wallace are full examples of it; and as the attention of those engaged in the investigation of nature being more than ever turned in this direction, illustrations confirmatory of it are being multiplied. In his later writings, Darwin acknowledged that he might not have assigned to it all the importance that it deserves, or the consideration to which it is entitled, and as investigation progresses, its influence in producing variation in nature is becoming more generally admitted. In tropical countries, where life is under a kind of forcing process, this power is strikingly exemplified in insects. There we find variation showing itself in the changed appearance of the same kinds of insects, within shorter distances and in greater numbers. Wallace tells us of one form of butterfly that he traced from the seashore inland until it was scarcely recognizable as the same species, so greatly did it change. This is an exceptional case, but the influence is present, if only the organism is sensitive enough to take the impression. Then consider, that a similar influence is at work to some extent, in some direction, on every form of insect life in the world, and we may form some conception of the tremendous power at work producing variation; for it is a fact well established by observation of life in domestication, that when a change has been brought about in an organism, it is easier afterwards to produce more and greater. But more; the same laws that are in operation at present, producing such results, have been at work ever since insects had an existence. Through all the various geological periods in which they have lived, this moulding and modifying influence has been going on, so it is not very surprising that the liability to vary should be so well established in their constitution now.

Because such a power exists in nature, we have no authority for supposing that it may go on indefinitely, and produce not only different looking things of the same kinds, but also different kinds. That would be contrary to the laws of nature as we know them, also to observation and experience. Each sphere of influence is well defined, whether we can trace it or not. It has a centre where it will be most powerful, and a circumference where it may be more weak, but if a change is to be brought about in the organism, a change must be made in its habitat, or it must be made to change its habitat. What difference would be produced by the change would have to be discovered by observation, if the organism survived it, for it is well known that conditions not necessarily fatal to life in themselves, might become so if brought about suddenly. Organisms do not change themselves by an effort of the will; this influence is external to themselves, and modifies them quite unconsciously to themselves.

What these influences are, or how they operate in producing a change in organisms, is at present but little known. Past observations point to chemical agency as a powerful factor. Indeed, in one view of it, the surface of the sphere on which we live is one huge chemical laboratory. The process of disintegrating matter and re-compounding it is perpetually going on. Then the various organisms are composed of multitudes of cells that are endowed with the power of choosing and absorbing from inorganic substances the materials required for their own special wants, and passing them on to other cells to be transmuted into the proper ingredients for the producing and sustaining of every organ in each and all, even the most complicated and highly organized beings on the earth. In the case of insects, heat and cold, moisture or its absence, light and obscurity have been shown to have an influence in changing their size and colour, the result, no doubt, of chemical combinations and actions. We see frequent instances of the same conditions producing opposite effects in different organisms, attributable to the inherent power of cells for differently combining the same materials or transmuting them chemically. And now that the conclusion has at length been reached, confirmed by correct scientific investigation, and one which harmonizes so well with all our observations and experiences, that heat does not come to us through space, but is chemically produced within our atmosphere in some way by means of the sun's rays, which are electrical, we seem to have got in some measure an explanation of how geologic and climatic influences obtain their power to modify organisms.

Although external influences are the most powerful originating cause of variation in living forms in nature, the most obvious one, and the one that attracts the most attention, is brought about by the intermingling of existing varieties, which tends to produce yet more abundant variation. The parents being unlike, we see some of the offspring taking after one parent, some after the other, some with a curious admixture of both; whilst others have no special resemblance to either. One does not require to travel in order to obtain abundant evidence of this.

In following out this part of my subject, I shall have occasion frequently to use the term *species*, so it will be well first to define the sense in which I use it. I remark, then, that I accept without reservation Worcester's definition of the term, which he states thus:

"1. Appearance to the senses or the mind; sensible or intellectual representation.

2. An assemblage of individuals allied by common characters, and subordinate to a genus or sub-genus; a group.

☞ In zoology and botany *species* is founded on identity of form and structure, both external and internal. The principal characteristic of *species*, in animals and vegetables, is the power to produce beings like themselves, who are also productive."

Here we have the term as used in connection with non-living matter used in classification, and as specially applied to living matter. In non-living matter, such as soils, rocks and inorganic substances generally, *species* are separated by appearances as they present themselves to the eye or mind. They are tested by the senses, when found to be different, they are pronounced to be specifically distinct. There are no differences of opinion as to their right to be called *species*; and the reason of it is, that they are inert and passive under external conditions. Specimens of the same species may be separated by thousands of miles, and that for thousands of years and no perceptible change has taken place in them. But living matter is constantly changing; from less to greater; from young to old; from vigour to decay; from one generation to another, all passing on to death and dissolution. What a gulf separates these two kinds of matter! or, if you will, the same matter under such different conditions. Now it is not in harmony with what is considered to be exact scientific phraseology, to apply the same term in the same way to two such differently constituted subjects of investigation; and separate *species* in living forms on exactly the same lines as in non-living matter. Taking "appearance to the senses" as the only guide to a definite conclusion; and yet that is what has been, and is yet being done by numbers of systematists and the result is, confusion and uncertainty.

Take as an illustration of how this method works in practice, the oft-quoted instance given in Darwin's "Origin of Species," p. 37. "Mr. Balington gives two hundred and fifty-one species to a given genus. Whereas Mr. Bentham gives only one hundred and twelve. A difference of one hundred and thirty-nine doubtful forms." Both are supposed to be competent authorities, why this vast difference in the result of an investigation of the same material? The answer to the question is to be found in the method of conducting it. Mr. Balington probably had a keen eye for detecting things that differ. He surveyed his material and separated it according to appearances, and when he was done he found that he had two hundred and fifty-one forms in which perceptible differences presented themselves to his mind, and he called them *species*.

Mr. Bentham was probably more critical. He might take into account the fact that living forms were always liable to vary more or less, and he would see that some of these forms so imperceptibly merged into one another, that he suspected that they were not entitled to be called *species*, so he united some here, and some there along the line, making their differences more perceptible whilst he reduced their numbers to one hundred and twelve, according to his estimate of what constituted a *species*.

Now that is exactly what might happen with any two investigators of a genus, with numerous so-called species upon this continent, who separated their *species* by perceptible differences. And that is probably what did occur in the genus that originated the "Colias Controversy," or the one that has started the Argynnis contention. Darwin himself worked on the same lines, and he has told in his own vigorous language what trouble he got into through it. He says: "After describing a set of forms as "distinct species, tearing up my manuscript and making them one "species, tearing that up and making them separate, and then "making them one again—as has often occurred to me—I have "gnashed my teeth, cursed species, and asked what sin I had committed to be so punished?" and such is the natural result of an effort to attain to certainty, by means of an uncertain method; and no amount of investigation upon the same lines, by ever so competent an authority, can ever be unmistakably certain. The only conclusive verdict must be obtained by an appeal to nature; unite the differing forms, and if they have "the power to produce beings like themselves who are also productive," then the species is one, and the different forms are portions of it. This is the law of nature controlling all bi-sexual life, and it is extremely doubtful if there has ever been a well authenticated instance of its violation. Cases have been reported of so-called different species having been united, and the product carried forward for several generations, but that simply proves that the term *species* had been wrongly applied; and this wrong application of the term by namers and describers of species is traceable to the method of making species exclusively from perceptible differences. To illustrate the danger to which such are exposed in following that method, I quote the following passage from Wallace's Island Life, pp. 55 and 56. "An American naturalist, Mr. J. A. Allen, has made elaborate observations and measurements of the birds of the United States, and he finds a wonderful and altogether unsuspected amount of variation between individuals of the same species. They differ in the general tint, and in the markings and distribution of the colours; in size and proportions; in the length of the wings, tail, bill and feet; in the length of particular feathers, altering the shape of the wing or tail; in the length of the tarsi and of the separate toes; and in the length, width, thickness and curvature of the bill. These variations are very considerable, often reaching to one-sixth or one-seventh of the average dimensions and sometimes more."

We see in this extract, the perplexity that must necessarily arise in the mind of those engaged in studying such variable forms from their point of view, as to how far this sort of thing may go before it becomes a different species. Now, man has demonstrated most conclusively in connection with his domestic animals, that no amount of that kind of variation interferes in the slightest with the various forms uniting, "and producing beings like themselves, who are also productive." And the same laws are operating upon life in nature in the same way. *Species*, is a question of lineage; not of size, form or colours. These are incidental.

Having given the manner in which I use the term *species*, I continue the subject of variation.

We have seen that there are a combination of influences at work in every habitable portion of the globe, producing a change in the appearance of the life of each, in proportion to the susceptibility of the species to receive the impression. That such spheres of influence have a centre and a circumference, well defined although to us unperceived, except by the effect produced. Long residence in a locality for many generations giving the influence of that locality an opportunity to exert its utmost on the species living under it, whilst propagations with the local stock will tend to produce a more distinctive form of a species, acting as in-and-in breeding does in domestication. A fact well illustrated by the life of Islands, which is as a rule more uniform in appearance than that of continents with their extended areas.

Now it is an acknowledged fact that insects are notorious for spreading; either from their innate desire to migrate, or by external assistance. So the particular forms of one locality are constantly getting mixed with the different forms of the same species in another locality; uniting with them, "and producing beings like themselves who are also productive." It is a well-known experience of breeders in domestication, that when differing strains of the same species are united, a great uncertainty exists as to what the appearance of the offspring will be; and the greater the difference is, the uncertainty becomes proportionately greater. But more, we have to take into consideration not only the late ancestors which we may have seen, but remote ancestry which we could not see, that may have had in them strains that we never suspected, until they showed themselves in those we see.

Now this commingling of different forms of the same species is constantly going on all over the habitable globe, and given time and opportunity a species, or its descendants, could encircle the earth and produce confusion amongst the typical forms of every locality.

And when we consider that the forms of each locality are thus pushing their way outward, to mingle with those of other localities, we have an abundant source of supply for unlimited variations from the well marked and easily defined forms of any species, to the most minute shades of differences that are well calculated to drive the makers of "Species by perceptible differences" to the verge of distraction.

Let us now throw the reins to imagination, and urge it on to its utmost capacity, for it can never exceed the truth in this direction, and conceive if you can the multiplied diversity of external influences that insects have been subjected to since they were first originated up to the present time. Think of the differences of the environments they may have lived in for a greater or less extended period, and that each and all were perfectly adapted to their times and conditions, harmonizing with and fitting into them as naturally and unconsciously as water fits into a vessel. That the surface of the globe has always been diversified in climate; that insects were as susceptible to external influences, as much given to migrating and mingling together the diverse forms of the same species, and thus multiplying diversity as now; and that this and a great deal more has gone on through all the geological eras and ages that have intervened between their first appearance and the present, there seems but little cause left for wonder that *species* should be difficult to define by perceptible differences. But lest the surprise should take the opposite direction, and the wonder be that classification is possible, remember that this has all gone on under the control of unchanging laws—the laws of life and heredity, with their marvellous power of colour and form, producing beauty and attractiveness; the laws of matter and force, those that make for change and those that tend to stability; chemical affinities and combinations; brought about through light, cold, heat, and electricity; change without haste, yet without cessation; almost imperceptible, but unmistakably accomplishing results; like some huge, complicated, perfectly adjusted, self regulating machine, so absolutely perfect in its operations that it has never needed alteration or repair since it was first set in motion. Or as the fabled mills of the gods that ground very slowly but very fine, whilst the outcome of the process is what we see. Here we have "descent with modification" throughout the ages, but the same species still, if in the direct line of descent.

In such plain and evident facts of nature we seem to get sufficiently powerful and persistent causes to bring about the superabundant diversity that characterizes insect life without entering upon those that are obscure and doubtful.

The period of existence when insects are most susceptible to external influences are in the egg, larval and pupal stages. It is in these that the impressions are received which afterwards show themselves in the changed appearance of the imago. When a change has been produced in the appearance of the mature insect, a change may reasonably be expected in its early stages. Therefore when different localities are possessed of influences that are capable of making themselves manifest in the different appearance of their mature forms, and the early stages of these forms partake of a corresponding difference, and they breed true to their particular forms through all their stages, it proves nothing whatever as to their specific standing. This for conclusive settlement will require the extremes of the mature forms to be brought together, united, and see if they will produce beings like themselves, who are also productive. If so, then the species is one, regardless of their differences.

My subject would seem naturally to end here, but there are views held by some that are not in harmony with those stated, which will suggest objections that can be anticipated and may be replied to here without departing from its general scope and purpose.

Some will be ready to say, if the species is one the name should be one also. I reply, that a single description can never cover a multiform species. A constantly recurring form that requires a separate description to make it recognizable, should have a separate name. This might have the effect of reducing the number of species and increasing the number of names. Mr. W. H. Edwards has somewhere said (I quote from memory and may not be exact): "We have no such a butterfly as *Ajax*. We have *Walshii*, *Abbotii*, *Telamonides* and *Marcellus*. These four forms constitute *Ajax*." Here it requires four descriptions and four names to correctly distinguish one species Mr. Edwards applies rinciple throughout his check list to all seasonally polymorphic butterflies. Let the rinciple be followed in dealing with all sorts of variations, amongst all kinds of and worked out in their classification, so far as is known, and what an amount of information could be conveyed at a glance as to the relationship of the different f any multiform species. We would have the different forms that are to be found rated localities in the same country distinguished by name, and the forms of the pecies found in other countries, continents or islands, with distinguishing names, their habitat might be indicated as well. We should have also the kind of varieties, er permanent local forms or incidental variations on these, brought about by the ingling of separate forms, varieties wholly the result of natural operations, or ced by man's interference with the course of nature in pursuit of his own ends, and ncluding the most recent variations; giving an opportunity to indicate forms that ave been exterminated through altered conditions, varieties seasonal, sexual or ountable, thus giving a world-wide view of every variable species according to the of knowledge procurable up to date, laying a solid and certain foundation for advances in the same direction. It would be an immense convenience if *species* be defined by appearance with certainty, but past experience has, so far, proved it ss. An approximation to the facts is the most that can be looked for. Ova, larvæ, upæ can all be classified by appearances as well as imagoes, but a system reared preparatory stages would fail of certainty as sure as on the mature one. No regu- graduated line can be formed of either, some inconvenient breaks are found in all. forms are found that will not fit in comfortably anywhere, whilst affinities are found ers that point in opposite directions. Yet for final arrangement and classification it is upon the affinities and resemblances of the mature form it ought to be founded, others being but preparatory thereto. So I conclude that the limit of *species* is by uniting two, when the beings produced are uniformly non-productive, but the of variation cannot be reached until the power to produce different conditions and inations has been exhausted.

SOME WINTER INSECTS FROM SWAMP MOSS.

By W. Hague Harrington, F.R.S.C., Ottawa.

Where are the insects in winter? What becomes of all the varied winged and ed forms that in the hot summer hours fill the air with movement and sound? Then nook and corner of the land has its tiny familiar folk, flitting from flower to flower, tless haste; every plant has its devouring hosts, and crawling, running, leaping ures swarm in every direction. With the shortening days and the approach of frost, yriads of insects, which have added so much to the joyous, exuberant life of sum- fast disappear and silence broods through forest glades and over meadow vales, which continuously with the shrill murmurings and stridulations of the innumerable stra. A few drowsy flies crawling on a sunny surface, or an occasional butterfly g in the midday warmth, may occur until winter has well set in, but these at last pear. The winds strip off the dead foliage, the frost congeals the surface of the d, and snow covers, beneath its chill pure shroud, a land from which all life seems to departed. "All the insects are dead" the thoughtless remark, forgetting for the nt that they will be as numerous and lively in the forthcoming summer, and that of the immense variety of forms will be created afresh.

Certainly the vast majority of the individuals, which are seen during the warmer n, perish before the close of the season, for the life of most insects is but a brief but the perpetuity of the species is preserved in spite of the apparent death of all dividuals. In some secure hiding places, then, the representatives of each species remain during the long months of frost and snow. Those who have not made a of our smaller forms of life would find it difficult to search out any of the swarms are waiting for the vivifying breath of spring. Some might remember that our flies have crawled away into cracks and crevices, from which to sluggishly emerge when it becomes warmer, but probably this would be the measure of their knowledge of the winter life of our insects. The entomologist, (concise term for the student of insect life,) however, who seeks to make himself acquainted with the complete life-history of each species, has as an essential part of his task to discover how the winter is passed. Naturally he finds that there is much diversity of habit, and that it may be either as egg, larva, pupa or imago, (adult or fully developed form) that the long cold months are safely tided over and the unbroken succession of the species preserved.

Many of our forms find security in the bottoms of the streams and pools, protected by the shield of ice which has been formed above them. Others are safely buried in the ground, beyond the reach of frost, or hidden in their burrows in our forest trees, but a great proportion are incapable of attaining such a degree of protection, and have to be content to hide in some crevice or similar shelter, or to depend upon such covering as they may be able to construct. It might well be supposed that those non-aquatic insects which hibernate in the perfect state would seek out some nice dry cranny in which, if possible, to shelter themselves from both cold and wet. Surprise may therefore reasonably be excited when it is discovered that a considerable degree of moisture seems in no degree harmful even to many species of a most delicate and fragile organization. The saturated frozen mosses of the swamps might appear the very opposite of suitable winter-quarters, and yet they very frequently contain an amazing number and variety of insects.

Having at several times gathered quantities of such mosses in the early winter, and obtained from them many interesting specimens, it has occurred to me that a brief summary of the result of my last foray of this sort might be of some interest to those who are curious as to the winter existence of our insects. I hope, too, that the list which I shall furnish may be of some little value to our many students in this branch of natural history, and may perhaps give some new light as to the habits of some of the species. For in all of our investigations we must bear in mind that, without a complete knowledge of the full yearly round of the existence of each species, we may perhaps lack just what it is most essential to know.

At the present time great attention is given to what is called economic entomology, which merely means the application to the benefit of the community at large of the knowledge which is slowly and laboriously gathered by many students, working generally merely for their own love of investigation, and often at considerable expense and self-sacrifice. At the Central Experimental Farm, at Ottawa, Canada has employed a very capable and indefatigable entomologist whose investigations and reports cannot but convey much needed information to the agricultural population. But the capacity of any man to make investigations is limited by the time at his command, and he is therefore compelled to avail himself of the labours of others, and as there is no one, especially if resident in the country and engaged in agricultural pursuits, who has not opportunity for observing the habits of some of our insects, there should be many who could render some aid to our excellent Government Entomologist, Mr. Fletcher, by communicating to him the observations that have been made. In devising methods for the destroyal and control of those insects which are classed as injurious (either to plant or animal life) it may become important to ascertain how they survive the winter, so as to know at what season they may be most easily and cheaply combatted.

Before proceeding with my list of species I will summarize for my non-entomological readers the method employed in collecting the specimens. The best localities for gathering the moss are to be found in swamps, surrounded and interspersed with trees and shrubs, and offering to the botanist in summer a considerable variety of plants. The ordinary sphagnum moss which may be found in some places is too wet to contain many insects, but the mosses which occur in abundance in somewhat drier localities will generally well repay investigation. It is profitable also to collect those which grow around the roots of trees, upon fallen logs, and upon the little knolls and hummocks of the swamps. The mosses, of course, will be mixed, more or less, with grasses, fallen twigs and leaves and various foreign matters, but the presence of these is not a source of any inconvenience in examining the material collected. A sackful gathered in the nearest swamp will furnish interesting occupation for many subsequent hours, and its contents ı be examined as opportunity offers. A damp, cool cellar is the best place to keep it til such opportunities occur. For the examination of the moss, take a shallow box, eral inches square and about three deep, and replace the bottom by fine wire netting about eight holes to the linear inch. Placing this box upon a sheet of white paper, a ndful of moss is torn to pieces in it, and the insects which may be present will fall rough the netting. Before emptying the debris out of the box give the latter a sharp p to dislodge any that may be "playing possum" or clinging to the wire. The insects ıich are now seen scampering off at different rates of speed may be picked up with a ıe forceps or the moistened tip of a camel's hair pencil, and dropped in a small phial alcohol or a cyanide bottle. It is well, if possible, to do this work in an uncarpeted om, or one in which a few spiders and other forms which will surely escape, may not eate any disturbance. Spiders especially display great alacrity in making themselves arce, and there are many beetles that are most agile in their movements, and even if ked up in the forceps will wriggle out and dart off in a new direction, always aiming, wever, for the farthest edge of the table.

By adding the species collected in previous years my lists could be lengthened but I tend to confine them to the results obtained from the gathering of one season. The aterial examined consisted of about a peck collected on 17th Nov., about the margins of little swampy inlet below the aboretum of the Experimental Farm, and the contents of ı ordinary grain-sack filled, six days later, in Dow's swamp, (a regular cedar and marac marsh) upon the opposite side of the canal. At the latter date the surface of ıe ground was frozen and some snow had fallen, so that the moss was partially frozen ıd mixed with snow, making the bag pretty heavy for portaging, and I remember that, hen I boarded an electric car with my burden, it provoked general curiosity (which mained unsatisfied) on the part of my fellow passengers. I have separate records of the sects from each place, but as the dates and localities were so near together I shall give ıt one list of the coleoptera, hemiptera and hymenoptera with the joint number of dividuals of each species, to show their relative abundance.

The total number of species enumerated is 147; of which 52 occurred in both localies, 59 in Dow's swamp only and 36 at the Experimental Farm only. The number of dividuals mounted and examined was 1,345, of which 889 were from the swamp and 56 from the Farm. These figures do not represent all the insects yielded by the moss, r of several of the commoner species no attempt was made to save all the examples, hile some individuals escaped in spite of all attempts to capture them. In addition ıere were numerous individuals belonging to some of the other orders of insects, such as ies, thrips, and spring-tails, of which there were several varieties always leaping around. here were also many allied forms, such as mites, spiders, chelifers and myriapods. mong the many larvæ of various kinds may be noticed especially one which was not frequent, and which afforded apparently a striking instance of protective mimicry. his was the larva of some fly, in which the segments of the body were so shaped and namented as to give the creature, which was of a bright green colour, an exact resemlance to a fragment of the moss.

The several varieties of moss contained in this gathering formed in themselves an teresting subject for examination, and in addition to the various forms of life already oted there were many examples of several of our smaller molluscs. Of these there were robably more than a dozen species, and they were preserved and handed over to one of ıy conchological friends to add to his collections and records. The examination of the ıoss was not concluded for several weeks, and it was found that its occupants remained live and active so long as it was not allowed to become too dry, or was not exposed to xcessive cold. Many of the insects proved most interesting and several had not reviously been found by me. I regret that about one-third of the species have not yet een satisfactorily named, which indicates that the knowledge of our insects is yet very nperfect, and that more students are needed in the entomological field.

COLEOPTERA.

CARABIDÆ.

Bembidium variegatum *Say*	2
sulcatum *Lec*	6
Pterostichus femoralis *Kirby*	12
Platynus picipennis *Kirby*	2
Lachnocrepis parallelus *Say*	1
Oodes fluvialis *Lec*	1
Tachycellus nigrinus *Dej*	3

DYTISCIDÆ.

Ilybius ignarus *Lec* ?	1
Ilybiosoma bifarius *Kirby*	1
Agabus sp.	1

HYDROPHILIDÆ.

Hydrochus subcupreus *Rand*	3
Hydræna pennsylvanica *Kies*	6
Philhydrus perplexus *Lec*	2
sp	2
Hydrocombus lacustris *Lec*	8
Hydrobius feminalis *Lec*	8
fuscipes *Linn*	1
subcupreus *Say*	6
Cercyon sp	2
Cryptopleurum vagans *Lec*	14

SILPHIDÆ.

Colon sp	4
sp	1
Clambus puberulus *Lec*	1

SCYDMÆNIDÆ.

Scydmænus fossiger *Lec*	40
sp. (small)	27

PSELAPHIDÆ.

Ctenistes piceus *Lec*	6
Pselaphus erichsonii *Lec*	15
Tychus longipalpus *Lec*	1
Decarthron abnorme *Lec*	3
Ratrisus globosus *Lec*	1
Bryaxis conjuncta *Lec*	68
rubicunda *Aubé*	9
propinqua *Lec*	128
Trimium sp	1

STAPHYLINIDÆ.

Falagria bilobata *Say*	6
dissecta *Er.* ?	1
Aleochara nitida *Grav*	4
sp	1
? sp	1
Dinopsis americanus *Kraatz*	1
Acylophorus pratensis *Lec*	2
Philonthus lomatus *Erich*	4
nigritulus *Grav*	7
decipiens *Horn*	2
Diochus schaumii *Kraatz*	16
Stenus femoratus *Say* ?	28
erythropus *Melsh*	2
pusio *Casey*	4
caniculatus *Gyll*	9
croceatus *Casey*	2
Euæsthetus americanus *Er*	3
Lathrobium punctulatum *Lec*	1
bicolor *Lec*	1
concolor *Lec*	2
simplex *Lec*	2
sp.	1
Stilicus dentatus *Say*	6
Lithocharis sp	8
Sunius binotatus *Say*	1
brevipennis *Aust*	2
Tachyporus jocosus *Say*	1

STAPHYLINIDÆ—*Continued.*

Tachyporus brunneus *Fab*	12
Conosoma sp.	2
Boletobius sp.	1
Mycetoporus americanus *Er*	5
Olisthærus substriatus *Gyll.*	1
? sp.	1
? sp.	44
? sp.	14
? sp.	5

TRICHOPTERYGIDÆ.

Trichopteryx sp	116
sp	6

SCAPHIDIIDÆ.

Scaphisoma convexum *Say* ?	2

CORYLOPHIDÆ.

Artholips marginicollis *Lec*	23

COCCINELLIDÆ.

Hippodamia 13-punctata *Linn*	1

CUCUJIDÆ.

Læmophlæus convexulus *Lec*	1

CRYPTOPHAGIDÆ.

Atomaria ephippiata *Zimm*	45
sp. (brown)	33
sp. (black)	1
sp. (small red)	24
? sp.	3

NITIDULIDÆ.

Omosita colon *Linn*	2
Ips fasciatus *Oliv*	4

LATRIDIIDÆ.

Stephostethus liratus *Lec*	1
Corticaria pumila *Lec*	53
cavicollis *Mann*	3

BYRRHIDÆ.

Cytilus sericeus *Fab*	2

DASCYLLIDÆ.

Cyphon variabilis *Thunb*	3

THROSCIDÆ.

Throscus alienus *Bonv*	1

BUPRESTIDÆ.

Taphrocerus gracilis *Say*	1

CHRYSOMELIDÆ.

Donacia Kirbyi *Lac*	1
Chætocnema subcylindrica *Lec*	5
Odontota nervosa *Panq*	2

OTIORHYNCHIDÆ.

Otiorhynchus ovatus *Linn*	2

CURCULIONIDÆ.

Apion sp	1
Phytonomus nigrirostris *Fab*	35
Listronotus sp	1
Macrops sp	3
Tanysphyrus lemnæ *Fab*	1
Acalyptus carpini *Hbst*	1
Pelenomus squamosus *Lec*	2
Cœliodes nebulosus *Lec*	1
? sp.	2

NOTES ON THE COLEOPTERA.

Two-thirds of all the species belonged to the Coleoptera, or insects in which the hind pair of wings, when present, are the organs of flight, and are protected by the thickened front pair, known as elytra. A large proportion of our beetles are ground-dwellers, roving about through the herbage and moss, or hiding under stones and rubbish, and these are best represented. Many of these are predaceous; the remainder feeding chiefly upon decaying animal or vegetable matter, and comparatively few attacking living plants. In the above list twenty-two families are represented by 103 species, of which forty occurred in both gatherings, while twenty-seven were peculiar to the Farm and thirty six to the swamp. The former locality furnished 383 individuals and the latter 594, so that, with the beetles that escaped or were not preserved, there were considerably over 1,000 examples in these mosses, which certainly shows that they were pretty thickly distributed throughout the swamps.

Of the seven species of Carabidæ, *Oodes fluvialis* was a new record for Ottawa, while *Lachnocrepis parallelus* is also an uncommon species here These beetles were found under the thick covering of a prostrate log, and were in shallow cells in the earthy matter on which the moss grew, evidently prepared to abide the winter there, as is done by other members of this family. The Dytiscidæ and Hydrophilidæ are aquatic or subaquatic beetles, although many of the smaller species live largely in decaying vegetable matter. The Pselaphidæ, a family well represented both in species and individuals, contains very small forms, which are stated to feed upon animal substances, and probably subsist in part upon other small inhabitants of the moss. *Bryaxis propinqua* and *B. conjuncta* are remarkably abundant, especially in Dow's swamp. Nearly one-third of all the species of Coleoptera belong to the Staphylinidæ, a very extensive family which I have not found time properly to study and of which there are many unnamed species in my cabinets, even of the commoner forms. These beetles are slender, depressed, elongated insects, with short elytra, remarkably quick and erratic in their movements, and living chiefly on decomposing animal or vegetable matter. The genus Aleochara contains, however, true parasitic species.

Of all our beetles the smallest species are those that belong to the family with the very long name, Trichopterygidæ, which signifies that they have wings fringed with hairs. One species was present in great numbers, and although mere black specks on the white paper the beetles are very nimble and run swiftly about. The members of the Cryptophagidæ and Lathridiidæ are also very small, and subsist upon fungi and decaying vegetation. One of the most interesting beetles of the list is the pretty little *Taphrocerus gracilis*, the only buprestid I have ever found hibernating. This species is taken with the sweeping net in low meadows in June and I believe the larva feeds in the stems of the sedges or large grasses. All the rest of the beetles are plant-feeding, and the most abundant species, *Phytonomus nigrirostris*, is known as a clover-pest.

HEMIPTERA.

Corimalæna pulicaria *Germ*	5
Neotiglossa undata *Say*	1
Cymus angustatus *Stal*	5
Salicia pilosula *Stal*	3
Scolopostethus affinis *Schill*	2
Lygus flavonotatus *Prov*	2
Corythuca arquata *Say*	7
? sp.	17*
Coriscus inscriptus *Kirby*	1
Salda sp. undescribed	1
Ulopa canadensis *VanDuzee*	62
Acocephalus mixtus *Say* ?	6*
Helochara communis *Fitch*	4*
Philaenus sp.	1
Livia vernalis *Fitch*	1

NOTES ON THE HEMIPTERA.

The species of Hemiptera include ten belonging to the division Heteroptera and five to the Homoptera. They were more abundant in the drier mosses. Seven species were common to both localities and four peculiar to each. The total number of individuals was 118, of which more than half belonged to the curious short-winged species which Mr.

VanDuzee has named *Ulopa canadensis* and which has been noted previously as occurring in Ottawa. Mr. Kilman has also found the species at Ridgeway, and it is probably widely distributed. The specimens marked with an asterisk were nymphs, or immature forms, so that the species could not be exactly determined. The insects belonging to this order are the only forms properly entitled to the name "bug," and they are mainly plant-feeding. Subsisting upon the juices, which they suck from the leaves and stems by means of the tubular beak formed by the prolongation of the mouth-parts, they rank among the insects most injurious to plant life, and are most difficult to destroy or keep in check. The smaller forms, known as plant-lice, are very numerous in species, and they multiply with great rapidity, so that a very brief time suffices for the attacked plant to become quite covered by the immense number in all stages of growth, and to have its vitality exhausted.

HYMENOPTERA.

PROCTOTRYPIDÆ.	
Megaspilus ottawaensis *Ashm*	5
Ceraphron minutus *Ashm*	4
flaviscapus *Ashm*	2
carinatus *Ashm*. ?	5
mellipes *Ashm*. ?	2
Aphanogmus bicolor *Ashm*.	8
Telenomus sp	1
Acoloides subapterus *Ashm*.	4
seminiger *Ashm*	1
sp. nov. ?	1
Bæus minutus *Ashm*	47
Prosacantha melanopus *Ashm*	1
Hoplogryon brachypterus *Ashm*	41
sp. nov. ?	1
Gryon canadensis *Ashm*	68
borealis *Ashm*	3
Paramesius clavipes *Ashm*	2
Diapria sp	1
Trichopria carolinensis *Ashm*	4

PROCTOTRYPIDÆ—*Continued*.	
Trichopria sp. (apterous)	2
sp	1
Phænopria aptera *Ashm*	16
hæmatobiæ *Ashm*	10
MYMARIDÆ.	
Cosmocoma sp	2
FORMICIDÆ.	
Camponotus marginatus *Latr*	1
Lasius brunneus *Latr*	1
Tapinoma erraticum *Nyl*	1
MYRMICIDÆ.	
Myrmica lobicornis *Nyl*	14
sp	1

NOTES ON THE HYMENOPTERA.

That this order should be so well represented will probably be a matter of much more surprise than the occurrence of a large number of the ground-frequenting beetles. One is apt to think of its members, in their adult form at least, as delicate-winged forms flitting about in the sunshine. But besides the ants there are many wingless or sub-wingless forms belonging to the various parasitic groups. Nearly half of the species in the above list belong to these non-flying hymenoptera, but the remainder have fully developed wings. It will be seen that twenty-nine species are enumerated, of which five occurred in both localities, five at the Farm only (of which four were ants) and nineteen only in the swamp, which was decidedly the most prolific ground, yielding 218 out of the 250 specimens collected. Many more ants could have been collected, for their nests, some of considerable size, were scattered all through the swamp, but those secured were stragglers that had probably got lost in their wanderings, and had not been able to reach home before the cold weather stopped their journeyings. With the exception of these ants all the species are very minute, and belong to the family Proctotrypidæ; except one species belonging to the Mymaridæ, a small group formerly included in the Proctotrypidæ but which Mr. Ashmead considers should constitute a separate family. The first six species belong to the sub-family Ceraphroninæ, whose members are parasitic on Aphididæ (plant lice) and Cecidomyiidæ (midge-like flies forming gall-like swellings, etc.). The following ten species belong to the sub-family Scelioninæ, all of which are egg parasites, the larvæ living in the eggs of other insects. I have bred as many as thirty-one individuals of a species of Telenomus from two eggs of one of our large moths, but usually one parasite occupies each egg. Seven species belong to the sub-family Diapriinæ, parasites of the larvæ of flies. The most abund ant form was the wingless *Gryon canadensis*, of which all but five specimens were from Dow's swamp. The closely allied, short-winged *Hoplogryon brachypterus* was almost as numerous, three of the specimens being from the Farm. The second in point of numbers was *Bæus minutus*, which occurred only in the mosses from Dow's swamp. Probably some individuals escaped my notice when I was sifting the moss, as it is much the smallest species in the list. It is a very agile atom, and able to leap a considerable distance, while even the least dust upon the paper suffices to hide it, as it is a mere speck itself. The whole forty-seven specimens placed head to tail would make a line hardly an inch in length. As the members of this genus are parasitic in the eggs of spiders this minute species will probably infest the eggs of some of our smaller spiders, but I have not yet succeeded in breeding any. The Cosmocoma is a fragile little form with narrow wings, interesting chiefly as being the first mymarid which has been captured by me, and probably the first recorded from Canada. In conclusion, it is hoped that these imperfect lists and notes thereon may stimulate further observations on the winter habits of Canadian insects.

BIRDS AS PROTECTORS OF ORCHARDS.*

By E. H. Forbush, Ornithologist of the Massachusetts Board of Agriculture.

Having had, during the last twenty years, some opportunity for observing the food habits of birds, I have become convinced that they destroy enormous numbers of insects. This conviction gives rise to the question, to what extent are birds useful to man in this respect?

The present paper is merely a partial record of the results of an attempt to foster and protect birds in an old and neglected orchard with a view to observing the effect of such a policy upon the trees. The orchard is so situated as to be a favorite haunt for birds. It forms part of an estate in Medford, Mass., lying near the southern border of the stretch of wooded rocky hills known as the "Middlesex Fells," a large part of which is now under the control of the Metropolitan Park Commission of Massachusetts, and is being administered as a forest reservation. The nearest estates on the east and west of the orchard are cultivated to some extent. There are other orchards in the immediate vicinity, and many fine and large shade trees. There are also on the estate in question many varieties of trees and shrubs. There is a small piece of woodland, covering perhaps an acre and a half, in which yellow pine predominates, the other trees being principally ash, oak and maple, some hickory and a few white pines. A lane running along the southern border of the estate is bordered on both sides with elms and poplars. A line of mulberry trees along the lane south of the orchard affords tempting food for such birds as are fond of fruit in its season. There are also many wild cherries and berries of several varieties, together with half a dozen trees of cultivated cherries.

Among the trees, shrubs and vines found on the estate and which furnish food for birds in the shape of berries or seeds at certain seasons of the year are the *Berberis vulgaris* (common barberry), *Vitis labrusca* (northern fox grape), *Rhus toxicodendron* (poison ivy), *Prunus Americana* (wild yellow plum), *Prunus Pennsylvanica* (wild red cherry), *Prunus Virginiana* (choke-cherry), *Prunus cevium* (English cherry), *Rubus occidentalis* (black raspberry), *Rubus villosus* (high blackberry), *Rubus idæus* (garden raspberry), *Rosa nitida* (wild rose), *Pyrus malus* (common apple), *Ribes rubrum* (common red currant), *Fraxinus Americana* (white ash), *Morus rubra* (red mulberry), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Pinus strobus* (white pine), *Pinus rigida* (pitch pine), *Thuja Canadensis* (hemlock), *Juniperus Virginiana* (red cedar).

The orchard itself is a typical old orchard, such as is often found on small farms. It has suffered greatly from neglect. Two-thirds of the original trees have died or are in the last stages of dissolution. This is largely the result of neglect and improper pruning. Dead limbs and hollows in the trees have offered nesting places for such birds as the wren, woodpecker and bluebird.

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For three years, from 1891 to 1893, inclusive, the trees were trimmed and cared for. They were sprayed or banded to protect them from canker worms, and the "nests" of the tent caterpillar (*Clisiocampa Americana*) (Fig. 27), were removed. The result was a scanty yield of apples from most of the trees. One or two bore quite plentifully.

In order to observe the effect of the feeding of birds in the orchard, no care was taken in 1894 to protect the trees. During that year the tent caterpillars were very numerous in the vicinity, and it became evident also that a great increase in the the number of canker-worms was taking place in the neighborhood. Although these insects made considerable inroads upon the trees, they did not seriously injure the foliage anywhere except in one or two instances. No attempt was made previous to 1895 to foster or encourage the birds in the neighborhood, except that a few nesting boxes were put up in 1894, which were occupied in one case by a family of wrens, and in another by the English or house sparrow. We were careful, however, to destroy the nests of the house sparrow.

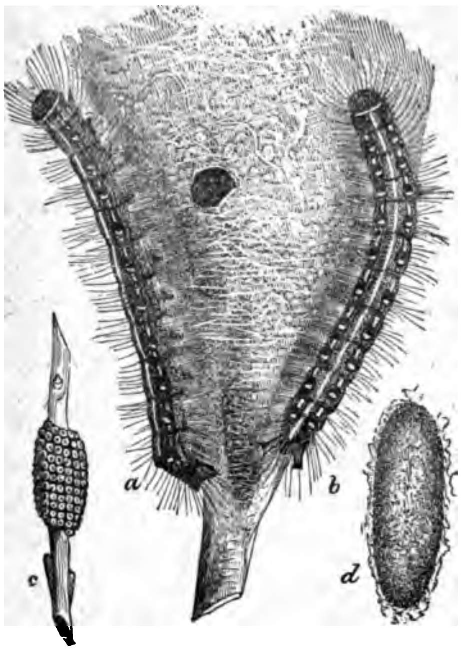

Fig. 27.

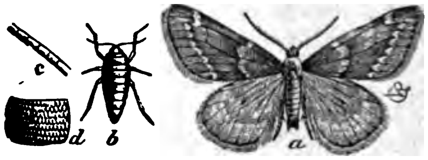

Fig. 28.

In the fall of 1894 it was noticed that immense numbers of the wingless females of the fall canker-worm (*Anisopteryx pometaria*) (Fig. 28, *b*), were ascending nearly all the trees and depositing their eggs; also, that the eggs of the tent caterpillar moths were numerous upon the twigs promising a plentiful supply for 1895.

Having allowed the insects one year to increase unmolested by man, we began in the winter of 1894 95 to encourage the presence of birds in the orchard.

In 1894 a small tree in the centre of the orchard had been enclosed by a high board fence. The tree thus enclosed was used as an outdoor experiment station for observation on the breeding and habits of the gypsy moth. During the winter 1894-95, Mr. O. E. Bailey made frequent visits to this tree to ascertain whether or not the birds were destroying the eggs of the gypsy moth. Incidentally, Mr. Bailey observed many interesting things in connection with the feeding of the birds on the eggs, larvæ and pupæ of insects which wintered on the trees, and I am greatly indebted to him for many interesting notes on the feeding of birds in this orchard. He is a careful, conscientious observer, and is intimately acquainted with most of our native land birds.

Hunters and trappers are aware that many species of winter birds, such as titmice, woodpeckers, crows, jays and nuthatches are attracted by a skinned carcase suspended from a limb, and will remain in the vicinity until all the bones are picked clean or until, with the approach of spring, insect food becomes more accessible.

Believing from my own observations that the chickadees (*Parus atricapillus*) were feeding on the eggs of the fall canker-worm, I asked Mr. Bailey to attract the birds, if possible, to the orchard by suspending pieces of meat, bone, suet, etc., from the trees.

These food materials are suitable for birds at times when the trees are covered with snow or ice and when, lacking such nourishment, they might starve. Although birds will frequently visit bait provided for them and in time will eat a considerable portion of the meat, they do not depend entirely on this aliment, but spend the greater portion of their time in searching for insects and eggs in the immediate vicinity.

Finding a plentiful supply of food, the chickadees remained about the orchard most of the winter, except for a week or two, when the meat gave out, but they were lured back again later by a fresh supply which was placed in the trees. Not only were the chickadees attracted to the orchard in large numbers, but other birds came also. A pair of downy woodpeckers (*Dryobates pubescens*) and two pairs of nuthatches (*Sitta carolinesis*) were frequent visitors, and a few brown creepers (*Certhia Americana*) came occasionally. All these paid frequent visits to the meat and suet, and also thoroughly inspected the trees in search of insect food. They made excursions also to the trees in the neighborhood, but the greater portion of their attention was confined to the orchard in which the bait was suspended. As they became more accustomed to Mr. Bailey's presence they grew quite tame, and could be viewed at a distance of a few feet. Indeed, chickadees frequently alighted on his person and occasionally took food from his hand. He was thus enabled to determine accurately (without killing them) what they were feeding upon, and was soon convinced that they were destroying the eggs of the canker-worm moth in large numbers, as well as the hibernating larvæ and pupæ of other insects injurious to trees.

To determine how many eggs a single chickadee would eat, a few birds were killed and their stomach contents examined, with surprising results. There was no difficulty in identifying the eggs of the canker-worm moth which were found in the birds' stomachs, as a great portion of the shells remained intact. The other insect contents of the stomachs were identified for me through the kindness of Mr. A. H. Kirkland, B.Sc., assistant entomologist of the State Board of Agriculture, who made the examinations. Although it was impossible in all cases to learn with certainty the species to which certain insects belonged, it was evident that they belonged to the genera known to be of injurious habits.

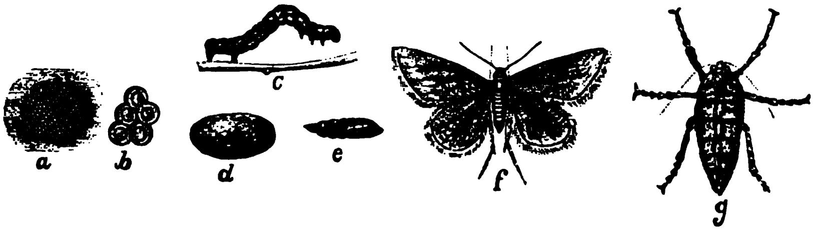

Fig. 29.

I take the following from Mr. Bailey's notes :

Number of Eggs of the Fall Canker-Worm found in Stomachs of Chickadees.

No. 1	273 eggs.
" 2	261 "
" 3	216 "
" 4	278 "

Making in all 1,028 eggs found in the stomachs of four birds. Four birds killed later in the season had eaten the female imagos of the spring canker-worm (*Paleacrita vernata*), (Fig. 29, *g*), as follows :

No. 1	41 moths.
" 2	18 "
" 3	27 "
" 4	19 "

Making a total of 105. In No. 2, 3 and 4 of the last table there were a large number of eggs also. It is safe to say that there were 150 eggs in each stomach, in addition to the female moths eaten.

Mr. Bailey carefully counted the eggs in the ovaries of twenty of these female moths, with the following results:

No. 1	158	No. 11	111
" 2	272	" 12	160
" 3	127	" 13	193
" 4	184	" 14	131
" 5	218	" 15	281
" 6	135	" 16	242
" 7	140	" 17	116
" 8	220	" 18	281
" 9	200	" 19	192
" 10	130	" 20	217

It will be seen from this table that the average number of eggs found in each moth is 185. Mr. Bailey is very positive, from his continuous field observations, that each chickadee will devour on the average thirty female canker-worm moths per day from the 20th of March until the 15th of April, provided these insects are plentiful. If the average number of eggs laid by each female is 185, one chickadee would thus destroy in one day 5,550 eggs; and in the twenty-five days in which the canker-worm moths "run" or crawl up the trees, 138,750. It may be thought that this computation is excessive, and it is probable that some of the moths were not captured until they had laid some of their eggs, but the chickadees are also busy eating these eggs. When we consider further that forty-one of these insects, distended as they were with eggs, were found at one time *in* the stomach of one chickadee, and that the digestion of the bird is so rapid that its

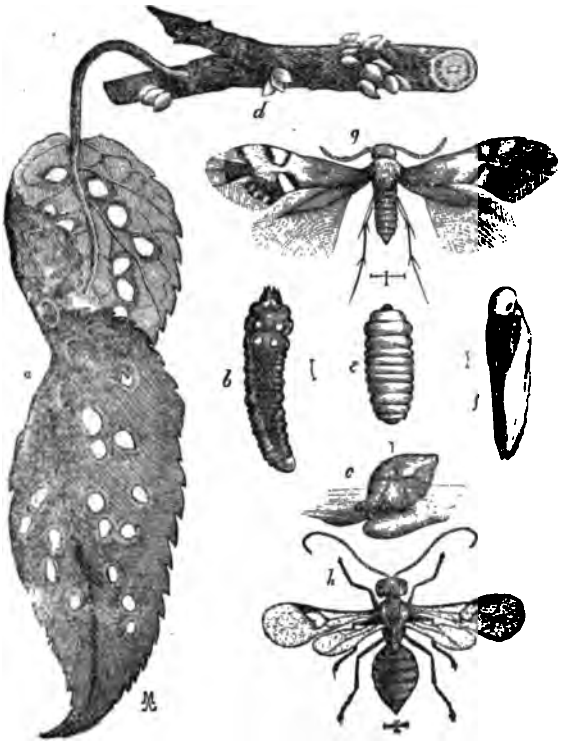

Fig. 30. (Aspidisca splendoriferella.)

stomach was probably filled several times daily, the estimate made by Mr. Bailey seems a very conservative one. He now regards the chickadee as the best friend the farmer has, for the reason that it is with him all the year, and there is no bird that can compare with it in destroying the female moths and their eggs. It was noticed that the birds made no attempt to catch the male moths. This, however, cannot be considered as a fault, for the birds accomplish far more by destroying the females than they would by killing males.

The following notes from the preliminary examinations of the contents of the alimentary canal of chickadees made by Mr. Kirkland are of interest in this connection :

"Bird brought in by Mr. Bailey, March 16, 1895 : Gullet empty. Gizzard contained 270 canker-worm eggs (*Anisopteryx pometaria*), forty-six case-bearers (microlepidoptera), six cocoons, Fig. 30*d*, of a small tineid (near *Aspidisca*). These three kinds of food in bulk composed eighty per cent. of the gizzard contents, the remainder being dark material which I was unable to determine under a hand lens. I think it very probable that part of this was bits of bark or particles of bark dust taken in with the eggs or cocoons. The intestine contained a large quantity of meat, seventy-five per cent., and 103 canker-worm eggs, ten per cent., the remainder, fifteen per cent., being material which I could not identify. It was not meat. This gives us as totals, 373 canker-worm eggs and fifty-one microlepidoptera.

"Specimens of so-called 'scales' on apple twigs brought in by Mr, Bailey, March 12, 1895. These are not bark lice, but the cocoons of a microlepidopteron, probably a tineid. Length 1-12 to 1-8 inch: width, 1-12 to 1-10 inch; elliptical, dark brown or reddish brown. They are closely spun, the upper surface apparently being of leaf epidermis, while underneath is a small well-formed cocoon which contains a minute green larva which evidently hibernates as such, probably pupating in the spring. The larva undoubtedly feeds on the leaves of the apple-tree, as these cocoons were taken from the small twigs at the extreme end of a large branch. Some of these cocoons are empty and have a minute hole at one end, which probably served for the egress of some small parasite. These cocoons are eaten by the chickadee, and have been found in the gizzard of the birds."

The case-bearers and the tineids or leaf miners are injurious to the foliage of the apple-trees.

It was noticed by Mr. Bailey, who watched the birds closely for several days, that they were eating quantities of both of these insects. It would have been impossible for any one to determine the species of the leaf miners as found in the birds' stomachs, for little remained but small fragments of the shell of the creature. Mr. Bailey noticed that the birds were taking objects from the twigs, some of which they ate; others they rejected and dropped upon the snow. Some of those dropped he picked up and examined, finding them to be parasitized. The birds undoubtedly ate only those which were alive.

It was evident from a careful examination of the eggs found in the stomachs of the chickadees that they were either broken by the bill in such a way that the contents were exposed to the action of the gastric juice or the gastric fluid destroyed a portion of the shell. Occasionally a few eggs which appeared to be whole were found in the intestines.

A great quantity of animal food is required to sustain life and provide animal heat sufficient to enable these little birds to resist the inclemency of our severe winters. In proof of this it may be stated that during favorable weather the birds visited the meat and ate largely of it three times each hour with fair regularity. During each interval they were occupied in destroying eggs and other hibernating insect forms which were always present and numerous in the stomachs examined. This feeding appeared to be almost continuous except in severe storms when the birds sought shelter or when they were laboring under excitement caused by fear, as in the case of a visit from a hawk, cat or shrike. Whenever a cat appeared they immediately hid behind the branches and remained quiet until the intruder had passed. The appearance of other enemies or the firing of a gun would produce much the same effect.

The woodpeckers and nuthatches which frequented the orchards, were not seen to eat the eggs of the canker-worm moth. As they were not numerous, none were killed. Mr. Bailey observed, however, that the nuthatches were eating scales which they found on the limbs of the apple-trees in a neighboring orchard. In relation to these scales the following note from Mr. Kirkland is of interest :

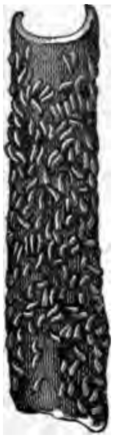

Fig. 31.

"March 20, 1895 Mr. Bailey brought in specimens of apple twigs infested with the Bark Scale louse, *Mytilaspis pomorum*, Fig. 31. He reported that the nuthatch was feeding on them. These twigs were infested in a worse manner than I have ever seen before. They were literally covered with the scales. On one small twig, one-half inch in diameter, I counted 367 scales on one inch of the twig. The eggs contained in a number of scales varied from sixty-two to eighty-two, with an average of seventy."

These scales, when numerous, are very injurious to the apple-tree. Each scale covered a dead female of the preceding year and the hibernating eggs, many of which must have been disposed of by the nuthatches. I was shown, both by observation and dissection, that birds feeding in the same neighborhood and upon the same trees showed considerable variance in the character of their food. Kinglets taken, had no canker-worm eggs, but had eaten largely of bark borers. Woodpeckers seemed to confine themselves to the larvæ of borers and to wood-ants and other insects which bore into the wood of the tree. Chickadees and nuthatches ate the pupæ and eggs of insects found upon the bark or in the crevices of the trunks. No birds were seen to eat the eggs of the tent caterpillar, nor were any found in the stomachs of any of the birds examined. It seems probable that these eggs are so protected by a hard covering that they are not eaten by most birds.

It is impossible, in the limited space at our command, to give results of all observations and dissections in detail. We can merely give the apparent results of the presence of the birds in the orchard.

It was found that these birds were not only destroying the eggs of the canker-worm in this orchard, but were feeding on the eggs of the same insect in the woods where bait had been suspended.

As the frost left the ground on the first warm days of spring the wingless females of the spring canker-worm moth appeared in the orchard and began ascending the trees in great numbers. The chickadees commenced catching and eating the females, and their eggs. Mr. Bailey placed twenty-two of the females on one tree, and in a few minutes twenty of them were captured and eaten by chickadees.

It was noticed as spring approached and insects became more numerous that the chickadees came very seldom to the meat. They were not as assiduous in their attention to the orchard, and a small portion of their food consisted of the early gnats which were flying on bright sunny days. In early April they had nearly deserted the meat, although they still frequented the orchard in search of the female canker-worm moths. They seemed to prefer animal food to all other, and even in cold weather would hardly notice grain or seeds of any kind, though one individual ate a few oat kernels which were placed near his accustomed feed of meat.

Towards the last of April the English or house sparrow (*Passer domesticus*) began to make its appearance in the vicinity and apparently drove the chickadees to the woods, as they disappeared and did not nest in the orchard, but remained in the woods, where they paired and nested.

I believe that the English sparrow is largely responsible for the fact that chickadees are not now found nesting in our orchards. Though they still nest in the orchards on the remoter farms and in the villages where the English sparrow is not numerous, they seem to have disappeared in summer from orchards near cities. At the time of the advent of the sparrow in this locality, twenty-five years ago, chickadees were often found nesting in old apple trees in the orchards in this region where now scarcely any are to be seen in orchards during the summer.

In the latter part of April and in early May the tent caterpillars made appearance on the apple and cherry trees in the neighborhood. Canker-worms were also numerous on the apples and elms and appeared in some of the other trees. It was noticed, however, that while trees in neighboring orchards were seriously infested with canker-worms and to a less degree with tent-caterpillars, those in the orchard which had been frequented by the chickadees during the winter and spring were not seriously infested, and that comparatively few of the worms and caterpillars were to be found there.

With the warm south winds of May, many summer birds came and settled in the neighborhood and prepared to build their nests, among which the following were seen: Chickadee (*Parus atricapillus*), Tree Sparrow (*Spizella monticola*), Crow (*Corvus Americanus*), Purple Grackle (*Quiscalus quiscula*), Flicker (*Colaptes auratus*), Red-winged Blackbird (*Agelaius phœniceus*), Robin (*Merula migratoria*), Chipping Sparrow (*Spizella socialis*), Ovenbird (*Seiurus aurocapillus*), Wood Thrush (*Turdus mustelinus*), Catbird (*Galeoscoptes carolinensis*), Brown Thrasher (*Harporhynchus rufus*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Black and White Warbler (*Mniotilta varia*), Yellow Warbler (*Dendroica æstiva*), Chestnut sided Warbler (*Dendroica Pennsylvanica*), Black-throated Green Warbler (*Dendroica virens*), Pine Warbler (*Dendroica vigorsii*), House Wren (*Troglodytes ædon*), American Redstart (*Setophaga ruticilla*), Nashville Warbler (*Helminthophila ruficapilla*), Golden-winged Warbler (*Helminthophila chrysoptera*), Scarlet Tanager (*Piranga erythromelas*), Rose-breasted Grosbeak (*Habia ludoviciana*), Baltimore Oriole (*Icterus galbula*), Blue Jay (*Cyanocitta cristata*), Least Flycatcher (*Empidonax minimus*), Wood Pewee (*Contopus virens*) Phœbe (*Savornis phœbe*), Kingbird (*Tyrannus tyrannus*), and Downy Woodpecker (*Dryobates pubescens*).

It was noticeable that early in the season, when the webs of the tent-caterpillar (Fig. 27) first appeared on the apple and cherry trees, the orioles attacked them and devoured a considerable number of the hairy young larvæ. A little later, when the canker-worms became more numerous, it seemed as if all the birds in the neighborhood were intent on eating canker-worms, neglecting to a certain extent the hairy caterpillars. The cuckoos, however, seemed to feed impartially on both the canker-worm and the tent caterpillar.

Birds from all quarters in the wood and swamp, orchard and field, flocked into the trees infested by canker-worms, and there spent a considerable portion of their time. In a short time the few canker-worms remaining in the old orchard were apparently eaten by birds, and the birds then directed their attention to the neighboring orchards, which were swarming with the worms It soon became evident that these orchards would be entirely stripped of their leaves, while the old orchard retained its full foliage. Thus it was seen that the trees to which the chickadees had been lured during the winter had been so well protected that the summer birds were able to destroy the few remaining larvæ, while the trees at a distance from these contained so many larvæ that the birds were not numerous enough to dispose of them or to make any effective reduction in their numbers. This apparently demonstrated the usefulness of the egg-destroying winter birds, and showed the wisdom of attracting them to the orchard during the winter months. Not only did nearly all species of birds in the neighborhood flock to the trees infested by the canker-worms, but the chickadees, living in their retirement in the woods, came out to the orchards, flying some distance to procure canker-worms with which to feed their young, and making regular trips to the infested trees day after day.

On May 18, Mr. Bailey saw a female chickadee carry twenty larvæ to its nest. They were apparently all canker-worms but two, which were tent caterpillars. Of this he is certain, for he was within three yards of the nest to which the larvæ were taken. Later, on May 31, he noticed the chickadees feeding their young. It was evident that a large portion of the food consisted of canker-worms. The birds each made a trip to the nest about once in twelve minutes. The male and female came at nearly the same time and went away together. They went in the direction of an orchard infested by canker-worms. A few of the larvæ were dropped on the ground at the nest and proved, on examination, to be canker-worms.

The crow was also observed feeding on the canker-worms.

On May 22 the birds had nearly all stopped feeding in the neighboring woods and were in the orchards feeding on canker-worms.

Early in June, when the remaining canker-worms had finished their transformations and retired to the ground, several species of birds were again noticed feeding their young on the tent and other hairy caterpillars. Of these, three species (both cuckoos and the Baltimore oriole) seemed to be the most useful. On May 17, a cuckoo was seen to take eleven caterpillars out of one nest. Mr. Bailey writes: "On May 10, a black-billed cuckoo came into a tree near me at 3 p.m. and sat there until 4.40 p.m., then he went straight to a tent caterpillars' nest. He looked it over for a short time and then commenced eating the caterpillars. He picked twenty-seven caterpillars out of the nest before he stopped. The bird ate them all and did not drop one. Then he went to the tree, in which, I believe, he remained during the night, for on Saturday, the 11th, I found the bird in the same tree, and in almost the same place, at 5 a.m."

The orioles, chickadees and vireos often pecked the caterpillars to pieces and ate portions of them, seemingly feeding to a considerable extent on the internal organs. This being the case, it is quite evident that the stomach contents cannot be depended upon entirely to determine the character of the food of these birds, as no one is expert enough to identify the internal organs of caterpillars with such certainty as to determine the species to which they belong.

The following is a list of the birds seen feeding on the tent caterpillar:

Crow (*Corvus Americanus*), Chickadee (*Parus atricapillus*), Oriole (*Icturus galbula*), Red-eyed Vireo (*Vireo olivaceus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Black-billed Cuckoo (*Coccyzus erythrophthalmus*), Chipping Sparrow (*Spizella socialis*), Yellow Warbler (*Dendroica æstiva*).

During the month of May an attempt was made to render the place as attractive to birds as possible. The undergrowth, which previous to 1894 had been trimmed out, was afterward allowed to grow, and in 1895 several low thickets had been thus formed. The mulberry-trees were stimulated by judicious trimming, and bore a considerable crop of early fruit which ripened in advance of the cherries, thus drawing the attention of the fruit-eating birds away from the cherries, and serving to attract them to the vicinity of the orchard. Ten nesting boxes were put up for the wrens and bluebirds; but as the bluebirds were very rare this season none came to the orchard. Two families of wrens, however, were reared in the boxes in place of one family last year. Nesting materials—strings, hair and straw—were hung in the trees and scattered about. Several marauding cats were killed, and an attempt was made to keep nest-hunting boys away from the neighborhood as much as possible. Thirty-six nests of birds were discovered in the neighborhood, as follows: Three red-eyed vireos, ten robins, four Baltimore orioles, three cuckoos, five chipping sparrows, three least flycatchers, two redstarts, two yellow warblers, two chickadees, two house wrens.

Of these all but three were destroyed probably by boys, the nests being torn down and the eggs missing. The three which escaped destruction were two wrens' nests which had been built in boxes upon buildings, and a robin's nest in a maple tree within ten feet of a chamber window. This wholesale destruction of nests discouraged several pairs of birds, and they disappeared from the neighborhood. Those remaining built new nests, and after a second or third attempt a few succeeded in rearing young. One nest of orioles escaped the general destruction, and the birds were busy for a long time carrying canker-worms to their young. One of them was noticed to take eleven canker-worms in its beak at one time, and fly with them to the nest. The vireos, warblers, chickadees, cuckoos, orioles and chipping sparrows were particularly active in catching canker-worms, and the English sparrow killed them in considerable numbers.

If the thirty-six pairs of birds whose nests were found had succeeded in raising their young, it is probable that they would have disposed of most of the canker-worms in the neighborhood. Five thousand of these larvæ are sufficient to strip a large apple-tree. One hundred and eight young would have been reared, had each pair of birds raised three. According to Professor Augley's experience, sixty insects per day as food for each bird, both young and old, would be a very low estimate.* Suppose each of these one hundred and eight birds had received its sixty insects per day, there would have been 6,480 caterpillars destroyed daily. The destruction of this number of caterpillars would be enough to save the foliage and fruitage of one apple-tree. In thirty days the foliage of thirty apple-trees could have been saved, or 194,400 canker-worms destroyed. This does not include what the old birds themselves would have eaten.

In these observations, the influence of insect parasites and predaceous insects has not been entirely ignored. Hymenopterous parasites were not seen to be numerous, and as it was a year when canker-worms were on the increase, it is not probable that these parasites would have been a prime force in reducing the numbers of the canker-worms had the birds not been present. Even had they been numerous they would have had little effect in checking the ravages of the canker-worm during the present year, as their interest is identical with that of the canker-worm, and they remain in its body until it has finished feeding, allowing it to defoliate the trees before completing their deadly work upon it.

We do not know to what extent such parasites are devoured by birds. This we could not ascertain without shooting the birds, which would have defeated our main object. No parasites of the tent caterpillar or canker-worm were found in the stomachs of the few birds which were examined. It is hardly safe to draw conclusions from observations so limited in their scope, but we may infer from what was observed that the egg-eating birds are of the greatest value to the farmer, as they feed almost entirely on injurious insects and their eggs, and are present all winter when other birds are absent. The summer birds which attack the larvæ are valuable also if they can be so protected and fostered as to become sufficiently numerous to do the work required. It is evident also that a diversity of plants which encourages diversified insect life, and assures an abundance of fruits and seeds, as an attraction to birds, will insure their presence. In this connection, I wish particularly to note the fact that the mulberry-trees, which ripen their berries in June, proved to be a protection to the cultivated cherries, as the fruit-eating birds seemed to prefer them to the cherries, perhaps because they ripen somewhat earlier.

I believe it would be wise for the farmer to plant rows of these trees near his orchard, and it is possible that the early June berry or shad berry (*Amelanchier Canadensis*) might also be useful in this respect. It is a handsome shrub or tree, flowering early in the season, and would be attractive at a time when other trees and shrubs are not in bloom.

At the present time, July 23, 1895, the trees in the orchard appear to be in good condition. They have not suffered from the slight pruning of their foliage which was effected by the few caterpillars and canker-worms which survived. The fruit is well set, and it now remains to be seen whether the birds will have any considerable effect in preventing the ravages of the codling moth. No other orchard in the neighborhood will produce any fruit this season, with one exception. The nearest orchard, situated directly opposite on the estate across the way, has not been ravaged by the canker-worms. This exemption is due principally to the efforts of the owner, who has banded his trees with tarred paper and has used tree ink faithfully and well upon the paper. He has also taken pains to clear the nests of the tent caterpillar from the trees. This orchard, being nearest to the one visited by the chickadees, was also an object of their attention, and this may account somewhat for the reduction of the pests in this place.

The record of these observations, incomplete as it is, is given for what it is worth as a contribution to the literature on this most interesting and important subject.

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* 1st Rep. U. S. Ent. Com. 1877, p. 342.

THE ROCKY MOUNTAIN LOCUST AND ITS ALLIES IN CANADA.

By Samuel H. Scudder.

The genus Melanoplus, to which the Rocky Mountain Locust belongs, forms part of a small group of genera first definitely separated a few years ago by Brunner von Wattenwyl under the name of Pezotettiges, but which, for reasons given in a technical memoir now in press, I have preferred to call after the dominant genus just mentioned,—Melanopli.

In the last resort, the Melanopli are separated from their nearest allies only by such an apparently insignificant matter as the number of spines (in itself variable) found on the outer margin of the hind tibiæ; these, save for individual exceptions, often on one side of the body only, are always at least nine in number and rarely exceed fourteen. In the known Canadian species they range from eight to thirteen, but ten or eleven is the almost invariable number.

The Melanopli are an almost exclusively American group comprising more than thirty genera of which only one, Podisma, occurs in the old world. They are primarily divided into two sections, dependent on the shape of the subgenital plate of the males, a division which broadly but not exactly separates the tropical or subtropical genera from those of the temperate regions, and leaves an almost equal number of genera in each section. Of the tropical section, as it may be called, but a single genus is known in Canada, Hypochlora; its single species *H. alba* (Dodge) is reported by Brunner as occurring in Manitoba, and this is altogether probable as it ranges along the border in the United States from Minnesota to Montana, but extends south only to Kansas and Colorado. It is a slender, hoary green, long-legged insect with abbreviated tegmina, and is partial to the white sage, *Artemisia ludoviciana.*

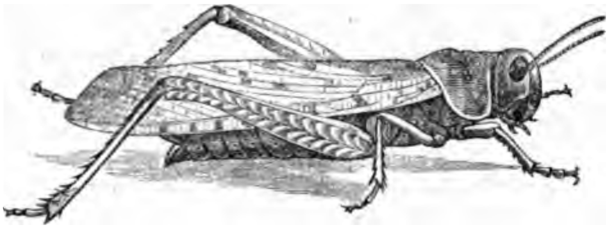

Fig. 32. Locust (magnified.)

Of the temperate section, only three of the genera are actually known to inhabit Canada, though, as we shall see, there is little doubt that others will be found there. One of these is Podisma, formerly known as Pezotettix*, a genus remarkable among the Melanopli for its longitudinal range, which is around the globe north of Lat. 35° N.; for its penchant for high altitudes, many of the species occurring only above or at the forest line on high mountains; and for the wide separation of its sternal lobes, though this alone will not separate it from all Melanopli. Moreover its organs of flight are never completely developed and may often be altogether wanting, as may then also, though in none of our American species, the tympanum found on the sides of the first abdominal segment; as this tympanum is regarded as an auditory apparatus, and as the power of producing sound is gone with the loss of the tegmina (against which the femora are scraped,) the absence of the tympanum in some apterous European species would seem to indicate that they had departed the more widely from the original type, and had therefore a longer history behind them.

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*See Psyche, vii, 195.

Up to the present time more species of Podisma are known from the old than from the new world; in the latter they are not known over a continuous territory, but over two large areas, one in the east and one in the west. That in the east is inhabited by only two species, one of which is only known from Ithaca, N.Y., at less than 500' above the sea, while the other, the better and long known *Podisma glacialis* (Scudd.,) was first found at the timber line in the white mountains of New Hampshire, and has since been obtained at high elevations 2-4500' above the sea, in Maine on Ktaadn and in the country about the Megalloway, in New Hampshire on Kearsarge in Bartlett, in Massachusetts on Greylock in Berkshire county, and in New York in the Adirondacks; while Mr. James Fletcher and I came across it at the edge of the town of Sudbury in Ontario. It will doubtless be found also in Quebec if sought in the proper places; it is not found upon the ground but upon bushes, in the white mountains on the dwarf birch. Bruner also credits it to "British America," but I do not know from what point he received it, and on enquiry I find it was probably a mistake.

The western area from which Podisma occurs has half a dozen species, which range along the rocky mountains from New Mexico to Alberta; all of the species are found on the mountain slopes or in Alpine valleys, and most of them at or above the timber line. A single species only is known to inhabit Canada, *Podisma Oregonensis* (Thom.,) which has been taken at Fort McLeod in Alberta, and is also known from Montana, Idaho and Oregon. It is highly probable that other and possibly new species will be found in the Canadian Rockies; it is especially likely that *Pod. dodgei* (Thom.,) one of the commonest alpine orthoptera in Colorado, and known also from Wyoming and Montana, will occur near timber line in Canada.

A second genus of the section which occurs in Canada is Phœtaliotes, a group founded by me for a single species, the somewhat anomalous insect *Phœtaliotes Nebrascencis* (Thom.,) of which *Pezotettix megacephala* Thom., *Pezotettix autumnalis* Dodge, and *Caloptenus volucris* Dodge, are all synonyms. It has a large, prominent, tumid head, which with a subsellate pronotum gives it a peculiar appearance; it is strikingly dimorphic, full-winged and half-winged, which accounts for a part of the synonymy. In Canada it has been found only in Alberta at Fort McLeod and in Assiniboia at Medicine Hat, but it ranges from here, skirting the eastern slope of the Rocky Mountains, to Texas and even to Central Mexico. I have not seen the long-winged form, volucris, from Canada, but it occurs from Mexico to Montana.

We have left for the last (though in systematic sequence it should have preceded Phœtaliotes) the typical, dominant genus Melanoplus, which contains most of the known Canadian species. This genus is so strikingly dominant as to contain more than one-half of the known Melanopli of the world. In the memoir referred to at the outset, I have described in detail no less than 131 species, all from North America and all but a very few found within the limits of the United States; it finds its principal home in the west, and it is to this genus that the Rocky Mountain Locust and several other minor depredators belong. To handle the genus properly I found it advisable to separate it into twenty-eight groups or series, defined mainly in terms of the male abdominal appendages, which here attain a striking and highly diversified development, and to name the groups after the predominant or older species contained in it. In that order I will present them also in the present account. Many of these species have before been placed under Pezotettix (Podisma) when I and others were accustomed, without careful discrimination, to look upon all the short-winged forms as belonging to that genus and the long-winged ones to Melanoplus. As some species are dimorphic, either fully winged or practically unable to fly from the brevity of the alary organs, that custom had its disadvantages, and a careful study of our entire Melanoplan fauna became a great desideratum, which I trust I may be found to have successfully filled in the paper before referred to.

In the *Glaucipes series*, there is a single species, *Mel. kennicottii* Scudd., a very small full-winged insect, which must be tolerably widespread in Canada, since it has been brought from the Yukon river in Alaska and the Souris river in Assiniboia, and occurs also in Montana.

In the *Utahensis series*, *Mel. bruneri* Scudd., a new species of about the size and general appearance of *Mel. femur-rubrum* but the male with a strongly upturned, apically broad subgenital plate occurs in Alberta at Fort McLeod, and extends from there southward to Nebraska and Colorado, and westward to Washington.

But it is in the *Spretus series* that the largest number of Canadian species appear. Most of them are closely allied to *Mel. atlanis*. Here are, first, *Mel. Alaskanus* Scudd., a new species found in Alaska and taken also at Spilmacheen, British Columbia ; next, *Mel. affinis* Brun., another new species found in British Columbia, Washington, Utah and Wyoming ; then, *Mel. bilituratus* (Walk.,) a common species on Vancouver Island, as well as on the mainland in British Columbia, and over the border in Washington, Oregon, Nevada and Montana; *Mel. atlanis* (Riley,) an extremely abundant insect, occurring throughout the breadth of Canada, from Sable Island, off Nova Scotia, to Vancouver; it extends northward to the Yukon river in the west, though in the east I have only seen or heard of it as far north as Quebec, Ottawa, Sudbury and Lake Winnipeg ; and finally, *Mel. spretus* (Uhl.,) the Rocky Mountain Locust, the arch-destroyer, whose home is in the high plateaux of the Rocky Mountains and their eastern versant as far north as the Saskatchewan, and which now and again ravages the country to the east by its migrating hordes.

In the *Dawsoni series* there are two Canadian species : *Mel. Dawsoni* (Scudd.,) which occurs in Canada from Manitoba to Alberta, and has two forms, long-winged and short-winged. Only the latter has been found in Canada, and the species ranges to New Mexico. The other Canadian species is *Mel. Gladstoni* Brun., which has been found at Medicine Hat in Assiniboia, and southward to Nebraska. Both these species are small and inconspicuous.

In the *Fasciatus series* are also two Canadian species : *Mel. fasciatus* (Walk.,) wide-spread in Canada, having been reported or seen by me from Newfoundland, Labrador north of the Straits of Belle Isle, Anticosti, Hudson Bay, Lake of the Woods, Manitoba, Saskatchewan, Assiniboia, Alberta and Alaska. It also occurs in the United States everywhere near the Canadian border, from ocean to ocean, and as far south as New Jersey, Missouri and Colorado. It again is dimorphic, but the wings in the brachypterous form are not very short, and the full-winged form is known only from Michigan. The second species of this group is the only Canadian species not found in the United States, *Mel. borealis* (Fieb.) I have seen it only from the barren grounds of northern Labrador, but it is also reported from Hudson Bay and Greenland. It has slightly abbreviated organs of flight.

In the *Femur-rubrum series* the well known *Mel. femur-rubrum* (DeGeer), Fig. 33 occurs over nearly the whole of Canada, from ocean to ocean, wanting only in some northernmost localities, such as Labrador ; and a second species, *Mel. extremus* (Walk.), ranges from Quebec to the Yukon and is dimorphic, though the organs are half as long as the body in the brachypterous type. The macropterous form seems to affect high altitudes or latitudes. I have seen specimens from the Alpine districts of the White Mountains and from Arctic America, among other places.

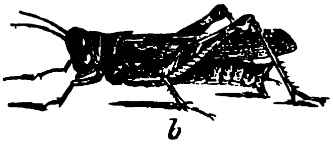

Fig. 33.

In the *Angustipennis series* the only Canadian species is *Mel. coccineipes* Scudd., a new species of moderately large size, found not uncommonly in Nebraska, Kansas, Colorado and Utah, and of which I took some specimens in company with Mr. Fletcher, at Nepigon, Lake Superior.

Mel. packardii Scudd., is the only Canadian species of the *Packardii series*, but this occurs abundantly from Assiniboia to British Columbia. South of the border it occurs over most of the United States west of the 100th meridian.

In the *Collinus series*, where all the males have forked cerci, there are several Canadian species : *Mel. alpinus* Brun., a very small new species, which ranges from Alberta to British Columbia, and is also known from Idaho ; *Mel. infantilis* Scudd., a still smaller form, originally described from Colorado, but found also in Assiniboia (Medicine Hat), and Alberta (Fort McLeod) and *Mel. minor* (Scudd.), a tolerably common species in the United States from Maine to the Rocky Mountains, and which was long ago sent from Red River, Manitoba, by Robert Kennicott and Donald Gunn.

Finally, in the *Bivittatus series*, where the species are large (the largest of those found in Canada), we find *Mel. femoratus* (Burm.,) which ranges from Nova Scotia to British Columbia, and extends as far north as Hudson Bay. In the United States it extends southward nearly to the Ohio, and on the Atlantic coast even to North Carolina, while in the west it is nearly confined to the northern tier of states, though it reaches along the Rockies to Colorado and along the Sierras to northern California. A second species, intimately related to the other, but with parti-colored instead of clear red hind tibiæ, *Mel. bivittatus* (Say), is a more southern form, but it occurs with the first in many places, and, in Canada, accompanies it from British Columbia to Manitoba, but not eastward.

It thus appears that ten of the twenty-eight series found in the genus Melanoplus occur in Canada, though but twenty species, or less than one-sixth of the known forms, are included in the list. The list is remarkable for three things: 1, the range of structural diversity as indicated by the number of series represented; 2, the total absence of all species with excessively abbreviated tegmina (*i.e.* only as long or scarcely longer than the pronotum), such as would formerly have been placed unquestioned in Pezotettix, the single one of the known Canadian Melanopli with such tegmina being a true Podisma; 3, that it includes three of the only four well marked cases of wing-dimorphism in the genus Melanoplus. It is true that both the dimorphic forms have not been found in Canada, but that is in all probability a mere accident, collections from Canada being much rarer. The dimorphism is probably co-extensive or nearly so with the species.

But it should not be concluded that the above list actually offers a fair idea of the true Melanoplan fauna of Canada. Canada is so little explored from a natural history standpoint, especially in its western portions where, in the United States, Melanopli are so very strikingly diversified, and so many additional forms have been found next the Canadian border, that we must believe that many of them surpass it and are not now known as Canadian, simply from the little attention paid in Canada to this order of insects. We propose, therefore, to conclude this account by a brief review of such Melanopli as may be looked for with some confidence; we shall discover the probability of a much more varied and numerous series, for the number of genera and species will both be doubled, and the "series" of the genus Melanoplus represented raised from ten to seventeen. All the additional genera, however, belong to the temperate section.

In the first place we may cite Hesperotettix as a probable inhabitant, since *Hesp. pratensis* Scudd., is widely diffused along the northern margin of the United States, from Minnesota to Washington, being recorded in my paper from these two States and all the intervening ones.

Then there is the genus Bradynotes, containing peculiarly broad-chested, robust forms with mere pads for tegmina, all the species of which are confined, so far as known, to the extreme northwest of the United States,—Washington, Oregon, Northern California and Idaho, with Nevada, Montana and Wyoming. No less than four species are found in Washington and two others in Idaho, besides one confined to California, so that it seems altogether probable that one or more of them may be found in British Columbia, if indeed this district do not prove to have its peculiar species.

The genus Œdaleonotus, founded by me on the species I formerly described as *Pezotettix enigma*, a clumsy bodied insect with tumid prozona and stout femora, and strikingly dimorphic in its tegmina, ranges on the Pacific coast from Southern California to Northern Washington where it is abundant, and it may almost surely be looked for in British Columbia.

Another new genus, Asemoplus, created for the reception of Bruner's *Bradynotes Montanus*, a relatively slender form, likewise with lobiform tegmina, has been found hitherto only in Montana and Washington and not further south, so that it probably ranges northward across the boundary.

15 To turn to the genera known to be represented in Canada, we have already mentioned the probability that *Podisma dodgei* (Thom.,) would occur in the Canadian Rockies; and it is by no means improbable that new species of this genus will also be found.

16 But for the bulk of the suspects we must naturally turn to the genus Melanoplus.
Here, in the *Flabellifer series*, we have *Mel. occidentalis* (Thom.,) known from Minnesota,
17 North Dakota, Wyoming and Montana; and *Mel. flabellifer* Scudd., occurring in
Wyoming, Montana and Idaho.

In the *Spretus series*, *Mel. intermedius* Brun., occurs abundantly in Wyoming, Montana, Idaho and Washington, and is, therefore, likely to occur in Alberta and British Columbia.

The *Indigens series* is composed of a single and new species, *Mel. indigens*, which comes from Idaho and may reasonably be looked for a little further north.

The *Mancus series* is another group not yet discovered in Canada, but which may be looked for, as two species, *Mel. Artemisiæ* (Brun.,) and *Mel. mancus* (Smith) are found on its confines: the former in the west on sage brush in Idaho; the latter in the east in Maine and New Hampshire.

In the *Dawsoni series*, an additional species may be looked for, viz: *Mel. militaris* Scudd., which occurs in Idaho.

Several species also of the *Rusticus series*, a group not yet recognized in Canada, probably occur therein : *Mel. Montanus* (Thom.,) found in Montana, *Mel. Washingtonianus*
18 (Brun.,) known now only in Washington, and *Mel. altitudinum* (Scudd.,) which occurs at
high elevations in Wyoming, South Dakota and Montana.

Of the *Borckii series*, *Mel. borckii* (Stal.,) is found in Washington, Idaho and Montana.

So, too, in the *Fasciatus series*, *Mel. saltator* (Scudd.,) occurs in the same States and in Wyoming, and may confidently be expected to extend across the border.

The *Alleni series* contains but two species, one of which, *Mel. Alleni* (Scudd.,) occurs in Iowa and Dakota.

19 One of the representatives of the *Cinereus series*, *Mel. cinereus* (Scudd.,) is of a very wide range, and is known from Washington, Idaho and Wyoming in places very similar to those abundant over the border in the sage-brush district.

20 Finally the *Collinus series* has probably other representatives in Canada, since *Mel. luridus* (Dodge) occurs abundantly in Washington, Montana, Dakota and Wyoming, and *Mel. collinus* (Scudd.,) is found in equal numbers in Maine and New Hampshire.

A considerable number of these species have tegmina no longer than the pronotum, so that should eventually all of them be found in Canada, what has before been said on this point regarding Canadian species would need to be materially modified. But in any event it seems plain that the Canadian fauna will prove much richer in species and genera than we now know it to be.

It should be added that many of the species mentioned above are as yet unpublished and are not always so specified; descriptions of all are in press.

SEVENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.*

The Association met in room 4, High School building, Springfield, Mass., August 27th, 1895. The following officers and members were present:

President John B. Smith, New Brunswick, N. J.; Vice-President, C. H. Fernald, Amherst, Mass.; Secretary, C. L. Marlatt, Washington, D. C.; R. A. Cooley, Amherst, Mass.; G. C. Davis, Agricultural College, Mich.; E. H. Forbush, Malden, Mass.; L. O. Howard, Washington, D. C.; A. H. Kirkland, Malden, Mass.; J. A. Lintner, Albany, N. Y.; C. V. Riley, Washington, D. C.; P. H. Rolfs, Lake City, Fla.; F. A. Sirrine, Jamaica, N.Y.; E. B. Southwick, Central Park, New York City; F. M. Webster, Wooster, Ohio; C. M. Weed, Durham, N. H.

There were also in attendance upon the meetings members of other scientific associations and entomologistis not members of the Association, among the latter Mr. George Dimmock and Professor Macloskie. The attendance at the different meetings ranged from 20 to 40.

The Association was called to order by the President and reports from officers listened to. The amendment to the constitution proposed by Mr. Summers, November 13th, 1890, but not afterwards taken up, was adopted. It reads as follows:

SEC. 3. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments, or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutes, may become members of the Association by transmitting the proper credentials to the Secretary and by authorizing him to sign their names to this constitution. Other persons engaged in practical work in economic entomology may be elected by a two-thirds vote of the members present at any regular meeting of the Association. Members residing out of the United States or Canada shall be designated foreign members. Foreign members shall not be entitled to hold office or to vote.

The following persons were elected active members of the Association:

Mr. W. Hague Harrington, Ottawa, Canada; Mr. R. E. Palmer, inspector of fruit pests, British Columbia. Proposed by Mr. Fletcher.

Mr. W. S. Bullard, Bridgeport, Conn.; Mr. John Gifford, State forestry agent, Mays Landing, N.J. Proposed by Mr. Howard.

Mr. E. A. Schwarz, Washington, D.C. Proposed by Mr. Marlatt.

Mr. E. H. Forbush, Malden, Mass.; Mr. A. H. Kirkland, Malden, Mass.; Mr. R. A. Cooley, Amherst, Mass. Proposed by Professor Fernald.

Mr. F. W. Urich, honorable secretary Victoria Institute, Trinidad, and Trinidad Field Naturalists' Club.

The annual address of the President, John B Smith, was entitled "Entomological Notes and Problems." He drew attention to the fact "that differences in results obtained by farmers do not always argue ignorance or carelessness, and that insects or insecticides may vary, either in resisting power or in effectiveness, in different localities, and that we must not hastily conclude that what answers in California will be equally effective in New Jersey, nor that the conclusions based upon the most careful experiments made in New York can be accepted unquestioned in Idaho," and stated, "that there are factors not yet understood by us that should make us cautious in recommending too positively or hastily measures based on results reached in localities different from our own, and on the other hand should make us very chary in condemning work done by a confrere because our results do not agree with his."

"The day of testing insecticides is therefore not so nearly over as has been sometimes thought, and we owe it to our constituent, where his results do not agree with our expectations, to test the matter under his conditions before deciding him incompetent; and it does not need the distance between the Atlantic and Pacific to make a difference in condition. Results obtained annually by dozens of farmers in New Jersey seem absolutely unobtainable by most careful experiments made in New York; while I have this season proved, much to my dissatisfaction, that the reverse may be equally true, for I can not secure the results in actual practice with bisulphide of carbon against cabbage maggots which Mr. Slingerland obtained in his experiments. Yet Mr. Slingerland undoubtedly recorded only what he found, and sooner or later the reason for the failure in New Jersey will be discovered. Each worker must therefore study his own field most carefully."

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*Through the kindness of Mr. L. O. Howard, Entomologist of the Department of Agriculture, Washington, D.C., we are enabled to give the following account of this interesting meeting.

He next took up the question of how to control the publication of entomological matter in newspapers in order to prevent the dissemination of erroneous statements, and mentioned the difficulties that he encountered in his efforts to do so. He then referred to the impossibility of keeping track of everything that is published on economic entomology, referring not only to bulletins and reports, but also to the articles published in agricultural journals and newspapers, and asked whether there might not be some feasible way of interchanging among the members of the Association, records of all articles containing original or useful information. He also suggested that some arrangement should be adopted for the interchange amongst the members of specimens of injurious insects and their work, and also the formation of a central collection of economic entomology.

He then dealt with the subject of legislation against insect pests and referred to the difficulty of arousing public opinion sufficiently in order to secure action. He also dwelt upon the importance of having some kind of inspection of trees and shrubs grown in nurseries before they were sent broadcast over the country.

" Perhaps I have spoken enough of problems and of difficulties—he went on to say—and should mention some of the accomplishments, some problems solved. Unfortunately there are none. Progress there has been in many directions, and of the most encouraging kind, but no striking successes, no epoch-making discoveries. We have not yet succeeded, for instance, in dealing more satisfactorily with grasshoppers; but it is decided progress to learn that in a single State several hundred 'hopper-dozers' are in use under the direction of the entomologist and that the State has realized the importance and necessity of this kind of work. Our good friend and fellow-member, Dr. Otto Lugger, has certainly succeeded in securing respect for his profession and a reduction of his preachings to practice.

" Chinch bug work continues in a number of States; but we are not much nearer a final decision concerning the actual value of the Sporotrichum as a destructive agent. The chief objection to it seems to be that it requires the intelligent co-operation of the weather to secure the best results, and the weather is notoriously unreliable except in so far that you may count with reasonable certainty that it will not be as you want it.

" In this very State of Massachusetts we have a striking example of a destructive increase of an imported pest—the gypsy moth—and an interesting experiment in the direction of its destruction by the State. There are to be two papers on this subject, I am informed, and there will probably be a discussion on the principles concerned in the matter of dealing with imported pests. But I will take the liberty of offering just a few remarks here, not on the methods employed, but on the general principles involved. Under our scheme of government the individual States jealously reserve to themselves all matters of internal interest, and the Federal authorities are excluded from all save a fairly well-determined class of subjects. But no State seems to owe any duty to its neighbors, and Connecticut cannot force Massachusetts to protect it from an invasion by any Massachusetts pest, nor can it claim damages for any resulting injury. Each State is thrown upon its own resources for the protection of its own citizens. Connecticut took no steps to restrain the spread of the pear midge, and New York and New Jersey, though they are sufferers by the neglect, can make no complaint; but these States have in turn left the matter to individual effort, and Pennsylvania and Delaware, when their turn comes, will most likely adopt the same policy of non-interference. There is nothing, in other words, to prevent the spread of this insect over the entire United States except the limitations imposed by nature itself. Just what they are remains to be seen.

" Massachusetts owes no duty to other States to protect them from the gypsy moth *She owes* a duty to her citizens only, to the extent that her citizens in a legal way themselves determine by their own representatives. If in protecting themselves they protect their neighbors also, they deserve no credit for this result and have no claim for assistance. Yet it is a very grave question whether Massachusetts is not entitled to the assistance of her neighbors or of the general government in her efforts to exterminate this insect. I am offering no opinion as to the possibility of extermination—I have expressed myself both ways and cannot find another—but is not this really a matter of national importance, and should not the national government have certain duties or powers in cases of this kind?

"It is said that nothing is wholly bad, and so I find it possible to see a good feature even in the continued spread and increased injury caused by such imported pests as the elm leaf-beetle. I believe that this creature has done more to arouse public interest in economic entomology than any other single factor for many years past. Our cities are the centres of public interest nowadays, and our metropolitan press voices its expression. Insect injury to agricultural products rarely excites more than a passing curiosity, but the depredations of shade-tree insects in streets, parks, or near-by country roads, and on the grounds surrounding country houses attract attention immediately and produce loud and continuous complaints. The press is interested, and through it the public, while those most vitally affected, the owners of fine shade trees, are induced to examine into a question which they would otherwise have considered as of not the least practical interest. It is from this point of view that I welcome the recent great spread and increased injury from this elm leaf-beetle. City and town authorities and village improvement societies have taken up the matter, have inquired into it, and have even made some more or less successful experiments; and these, if continued, as they must be from the nature of the case, will produce an increased interest in and appreciation of economic entomology. Insecticide machinery and a knowledge of the application of remedial measures against the more common pests will be required of each park department and its employees, and the entomologist will be as important an officer as the landscape gardener. * * *

"I have noted an increasing tendency of late to attempt the control of insect pests by methods of cultivation or farm practice, and this, in my opinion, is much to be commended. There are periods in the life histories of many insects when they can be easily reached if we only know how, and where resort to some simple bit of field practice may prevent injury. A good example of this is seen in the practice of cutting close to the surface all shoots of blackberry about June 20 to prevent injury from the *Agrilus ruficollis*. All the eggs have been laid at that time, and the new shoots will be exempt, of course, while the larvæ cannot develop in those that have been cut down and will die. The whole matter seems so simple now, and yet it is less than two years ago that this was practiced almost simultaneously in New Jersey and Ohio.

"Preventing injury from the larvæ of *Melittia ceto* in late squashes by planting summer varieties upon which the eggs are laid and in which the larvæ are afterwards destroyed is another method which has been worth many hundreds of dollars to farmers on Long Island and in New Jersey.

But there is yet much to be done in this direction, and I am convinced that in the future "circumvention" will be practised in many cases where we now use poison. Farm practice, using this term in its widest sense to include the mechanical treatment of land, selection of fertilizers, date of planting and harvesting, rotation of crops, etc., will in time give us control of many injurious species which at present seem beyond our reach. It must be our aim to ascertain as far as possible the circumstances least favorable to the development and maintenance of the troublesome species, and then our attempt must be to produce just those conditions.

"We should, I think, whenever possible, lay great stress upon the importance of destroying crop remnants when they are no longer needed. For instance, cucurbit vines are usually left on the ground after all the crop is off, affording abundant opportunities for the maturing of *Anasa tristis*, the melon lice, and other pests. Removing them when no longer needed and destroying will save much trouble during the year following. Systematically burning potato vines as soon as the crop is harvested will prevent all danger of injury from the potato-stalk weevil (*Trichobaris 3-notata*), and I might cite many other cases were it necessary. We should also set out the advantages of winter work against many kinds of insects in orchard, vineyard and garden, and the desirability of destroying by fire everything that comes under the head of rubbish. Especially against certain kinds of hemiptera this sort of work would prove effective, and fire, judiciously used, can be made a valuable friend. So, much of the pruning should be done at this season, where the character of the plant warrants it, and if the cuttings be burnt many ova of insects will be destroyed. But I am telling you old facts which you do not care to hear. My purpose was not to offer them as information, but to urge their more forcible presentation to the farmer, and to indicate that in my opinion the future development of our dealings with insects will be along this line. * * *

"On the whole, I may repeat, we have rather cause for congratulation than otherwise. Our favorite branch of scientific investigation has made continuous and healthy progress; we have firmly established the reason for our existence and have impressed the general public with a dawning of appreciation for the work we are doing. Our session here will, I doubt not, improve our standing, and will at all events be profitable to those taking part."

Professor Fernald discussed interstate entomological problems with particular reference to the gypsy moth and the attempts to get the work against this insect undertaken by the General Government. He referred also to the difficulties arising from the conflict of interests of different States.

The first paper on the list, "Notes on Insecticides," was read by Mr. C. L. Marlatt, in which he described at length a series of experiments that he had made in order to thoroughly test the various apparatus that had been designed for spraying with kerosene oil and water, the results of which were not entirely satisfactory. He then treated of various insecticides, viz., soaps, arsenate of lead, cyanide of potassium and arsenite of copper.

AFTERNOON SESSION—AUGUST 27, 1895.

A paper by Mr. H. E. Weed on "Some Experiments with the Knapsack Kerosene Attachment," was read in his absence by Mr. Davis. In it the writer set forth the advantages that are claimed for the use of this mechanical mixture of kerosene and water over the familiar kerosene emulsion. It was followed by a paper by Mr. Clarence M. Weed on "A Modification of the Kerosene Knapsack Sprayer," in which he reported a series of tests of the knapsack sprayer with kerosene attachment, showing that the principal machine now on the market is unreliable in its present form. The chief source of error appears to be due to the continual differences of level in the kerosene and water tanks. To avoid this a kerosene attachment had been made at the New Hampshire Experiment Station, and was exhibited, of the same height as the water reservoir and holding one-tenth as much. A stopcock with a single hole one thirty-second of an inch in diameter connected the kerosene reservoir with the pump. By this arrangement a fairly constant spray having nine per cent. of kerosene in it was obtained. The opinion was expressed that to get successful results we must abandon the idea of having a large range of variation in one combination of reservoirs—*i.e.*, in expecting to get either a five per cent. or a thirty per cent. emulsion by turning a stopcock at a less or greater angle. The author believed that the kerosene sprayer was capable of great improvements along the lines indicated, and thought it too great an advance in methods of insect warfare to be lightly abandoned.

The following communication on "Spraying Without a Pump," by Mr. J. M. Aldrich, was in the form of a letter to the Secretary, accompanying a working sample of the apparatus. The apparatus itself and the manner of working it were described by the

Secretary with the aid of blackboard illustrations. The following is an abstract of the letter :—The spraying device which was suggested by the author to the association last year was again presented to call attention to two changes in the machine from the first idea. First, it is necessary that the stream from the hydrant enter the lance within rather than beyond the entering point of the insecticide ; second, the Nixon nozzle is entirely inapplicable to this form of apparatus, for the reason that it chokes the flow so as to destroy the suction in the insecticide tube. No nozzle has yet been devised free from this objection, except a plain deflector tip. The author is aware that a deflector does not give so good a spray as can be obtained in other ways, and hopes yet to overcome this objection.

The spraying device consists of a sort of lance, forked at the base. One fork connects with a hose to a hydrant or water supply under pressure, and the other with a tube leading into the vessel containing the insecticide. Both forks are provided with stopcocks. The suction caused by the passage of the water through the lance induces a flow through the fork and hose leading from the insecticide.

To use the apparatus, attach to an ordinary lawn hose by the large coupling. Turn on the city water, and it will be at once perceived that there is a strong suction through the small or insecticide tube. Put the end of this in a pail of water or kerosene, and, in the case of the apparatus experimented with, sixteen per cent. of the total discharge comes through it, the stopcock being wide open. By partly turning off the stopcock the proportion of kerosene can be reduced at pleasure, and the percentage may be indicated by graduations on the back part of the stopcock.

For Paris green, make up a pailful at the rate of one pound to twenty-five gallons of water, and when drawn through the machine it will be diluted at the eight per cent. kerosene gauge mark to one pound to 150 gallons and thoroughly mixed.

The device was experimented with by the inventor with a water-pressure of seventy-five pounds, which was inferred to be an average for city water.

No claim to novelty for this device was made except in the application. The principle is the same as that in the "jet pump" used for draining out barges, cellars, etc.

If the instrument deserves any name, it is suggested that it be called the Idaho jet sprayer.

Discussion of the foregoing papers followed. Mr. Southwick had canvassed the question of spraying from hydrants in his work in Central Park, New York, but had found it impracticable on account of the insufficient pressure of the water and the small number of hydrants. He said he was devising a steam pump which he hoped would give greater satisfaction than any apparatus hitherto used.

Mr. Davis suggested that any apparatus dependent on a constant water supply, as of hydrants, would be more feasible in the West in connection with irrigation plants.

Mr. Howard remarked that a stream produced by a pressure of seventy-five pounds to the square inch, mentioned by Mr. Aldrich as obtained from his hydrants, was quite sufficient to kill insects, with the exception of scales, without the addition of oil.

Mr Lintner asked if the oil and water mixture referred to in the various apparatus described in the papers could be properly considered an emulsion.

Mr. Marlatt said that an oil emulsion was merely the breaking up of the oil into minute globules in the emulsifying agent,and that on this basis the water and oil mixture, as long as permanent, was as properly an emulsion as the kerosene and milk mixture. He referred also to the fact that emulsions are often made with solid ingredients, as powdered lime.

Mr. Southwick referred to a nozzle which had lately come under his observation, which effects the mixture of the insecticide element with water at the moment of spraying. He had not yet experimented with it.

Mr. Marlatt said that from the description Mr. Southwick undoubtedly had in mind the Gillmore nozzle (to which Mr. Southwick assented), and said that Mr. Gillmore was at the Department, and some very careful tests were made with this nozzle with various insecticide agents. The character of the nozzle and the practical objections to its use were then pointed out.

Mr. Forbush said he knew of a similar principle at one time employed by a fire apparatus company to mix a fire extinguisher with water at the moment of spraying.

Mr. Smith said it was very encouraging to see such decided interest taken in the manufacture and improvement of machinery for the application of insecticide mixtures. He was of the opinion that the origination of new devices and the work of perfecting old ones or overcoming mechanical difficulties may be safely left to manufacturers, whom he had always found very ready to adopt suggestions in the matter of the betterment of apparatus. In this connection he referred also to the adoption by the Climax Pump Company of an improvement in the kerosene knapsack sprayer suggested by Mr. Goff. His experience with the improved knapsack sprayer, he said, corresponded very closely with that detailed by Mr. Marlatt.

Mr. Marlatt, referring again to the device suggested by Mr. C. M. Weed, pointed out that while the arrangement of the kerosene and oil reservoirs suggested by this author would probably obviate several of the difficulties, still an important objection, arising from the oil escaping into the water chamber during the action of the pump or immediately thereafter, was not corrected by this means, although possibly rectified by the combination suggested by Mr. Goff in a communication in Garden and Forest of April 10, 1895.

Dr. John B. Smith read the following paper :

"RAUPENLEIM" AND "DENDROLENE."

"Raupenleim" and "dendrolene" are both crude petroleum products of a butter-like consistency at ordinary temperatures and becoming only slightly softer at high temperatures. The raupenleim is a German product, very dark in colour, with a tarry odour and probably mixed with some tar preparation. The American product is brown in colour, almost without odour, and without foreign admixture to disguise its character or give it a specific smell. Raupenleim is largely used in Germany to protect trees from the attacks of certain insects and to prevent their being injured by stock or deer during the winter. The materials were tested comparatively for the purpose of preventing borers from attacking fruit trees, and if possible to prevent their issuance when already under the bark. Both materials can be readily applied with a paddle or trowel and distributed by means of a stiff brush so as to make a tolerably even coating. Experiments showed that it did not injure even young shoots where applied to the bark only ; but where buds or growing tissue were covered it killed the buds and shoots by choking the stomata. A young tree set out in 1894 was covered from the surface of the ground to the buds without detracting from its vigour during the balance of the season. It was applied upon an orchard of pear trees infested by the sinuate pear borer and both materials prevented oviposition. The raupenleim absolutely prevented the issuance of all the beetles maturing under the bark. The dendrolene did the same where thoroughly applied. The raupenleim has a tendency to harden on the surface. This is a good thing where it is intended to prevent beetles from issuing from the trees, but a bad thing where it is intended to prevent insects from crawling up the trunk. The dendrolene becomes very soft at high temperatures without running. This prevents insects from crossing it; but where it is applied thin it does not always form a barrier to insects emerging through the bark. Its application is recommended as against the fruit bark-beetle (*Scolytus rugulosus*), which can not emerge through it when already in the tree, and can not enter the bark protected by a coating. It was also tested against peach borers, and both materials proved effective.

It was stated by the grower conducting the experiments that the dendrolene killed the borers that were in the tree when it was applied, while the raupenleim did not. This fact may have been accidental and is not to be expected under ordinary conditions. The material is recommended for application to fruit trees to prevent attacks of round and flat-headed borers, and also wherever it is desirable to prevent insects from ascending or descending the trunk. A broad band, put on thickly, is recommended against the codling moth, and, in cities, against the white-marked tussock moth and the bag worm. It is suggested that applied on trunks on which insects like the pear psylla hibernate it will destroy these insects by preventing their coming out in the spring.

The cost of the raupenleim, free on board in New York city is, for twenty five pounds, $3.75 ; fifty pounds, $6.75 ; one hundred pounds, $12.75 ; barrel, from 250 to 275 pounds net, about $25. Dendrolene is supplied free on board at six cents a pound in New Brunswick, N. J., in lots of twenty-five to fifty pounds, and at 5½ cents in lots of one hundred pounds and over. The material can be washed from the trunks of the trees if desired by a strong potash mixture, say one pound of potash in a gallon of water. As the substance is a mineral product, it does not become rancid.

In answer to a question as to the composition of the lime, Dr. Smith stated that it was chiefly, if not entirely, crude mineral oil.

Mr. Southwick read extracts from a letter from agents for an imported insect lime, which were very extravagant in statement.

Mr. Fernald said he had experimented with the lime against the spring canker-worm, in conjunction with other experiments with printer's ink, the latter applied on paper bands, and banding the trees also with cotton, two or more bands being placed on the same trunk. Very few worms passed over the cotton bands, considerable numbers over the ink bands and a few over the lime. The larvæ chiefly effected their passage over the latter on cool mornings, which indicates that very diverse effects may be expected in different climates. He thought that of the three substances experimented with the imported or raupenleim gave the best results.

Mr. Howard asked what period of the year was included in the five months during which the lime was on certain trees.

Mr. Smith replied that they were the five months immediately preceding the middle of July.

Mr. Lintner suggested that the lime be so thinned down that it could be sprayed, to facilitate application.

Mr. Smith stated that this thinning would be especially desirable for work against scale insects, but that even when considerably thinned it could not be sprayed through an ordinary spraying nozzle.

Mr. Forbush said he had not his notes with him and therefore could not give in detail his experience with lime, which had been very extensive. He had used the raupenleim and an American material, Menzel's brand. He had found considerable difference in imported material obtained in different years. Sometimes it had proved very unsatisfactory and he had discontinued its use for other methods which he deemed more advisable for his work. He said that some insects can cross the lime, but when it is warm, and especially on sunny days, it is a nearly perfect barrier. On cold days, and particularly in stormy, rainy weather, insects can pass it with comparative ease. On smooth bark it will run somewhat, and will also crack or break, especially on rough-barked trees. German authors, he stated, claim that no injury results to the trees from its application, and his own experience was confirmatory of this. The only injury he had noticed came from the scraping prior to the application of the lime or injury from the lime as a result from such scraping of the bark. On dusty streets the lime soon crusts over and may be crossed by insects, and pine needles adhering to it produce a similar result. It is claimed by some that limed trees are not frequented by birds, but this idea was not confirmed by his own experience. He had used various machines and various devices had been constructed by the commission for the application of the lime. The necessity in cities or public parks of applying the lime at considerable heights on the trunks to prevent contact with it on the part of passers-by rendered many machines for its application impracticable for his purpose, and he had been compelled to employ chiefly paddles and trowels. European machines were found to be crude and somewhat unsatisfactory. He said that in Europe the lime was employed also as a coating for egg masses to prevent the escape of the larvæ. The objection to this was that such egg masses were very apt to be broken open by squirrels and the larvæ thus enabled to escape at the proper time. He thought lime would be of value, particularly against the canker-worm. He had found in certain instances that after lime had been exposed on trees during summer and winter the following spring it was still of a consistency to be of service.

Mr. Smith said that the dendrolene referred to in his paper is entirely without odour, whereas the European lime smells very strongly of tar. He was of the opinion that this odour was given to the European product to conceal its true composition.

Mr. Davis had tried wool bands with parallel experiments with raupenleim against canker-worms, and found the latter successful in every instance; but this could not be said of the wool bands. He had found lime impracticable against cut-worms, many of them crawling over it in the cool of the evening; and it had not proved entirely satisfactory against the peach borer, as the borers frequently emerged in spite of the coating of lime.

Mr. Smith said that this would be very probably the case if the application were made to the peach after the larvæ were in the tree, but that the application would be more successful if used to deter the moth from ovipositing.

Mr. Southwick said that in his experience he had found the tussock moth larvæ so numerous that they had been able to crawl over the lime on account of mere numbers.

Mr. Smith said this would not occur in the case of young larvæ.

Mr. Forbush said larvæ would bridge over any band when very numerous, and that such a result could only be prevented by visiting the bands and collecting at frequent intervals the larvæ accumulated beneath.

Mr. Smith said that the American product referred to in his paper was less affected by extremes of temperature than the European lime. He was convinced that in insect lime we have a valuable means of defence against many insects, but that there was room for considerable improvement at present.

Mr. Forbush said that while he had discontinued it for other reasons, he believed that there were great possibilities in the proper use of insect lime.

Mr. Fernald, referring to the Russian lime, said that all the material probably came originally from Germany.

Mr. Smith stated that the constituent elements of the lime very possibly came from the oil regions of Russia.

Mr. Marlatt said the Department of Agriculture had received samples of this raupenleim, and called attention to the very strong similarity between this substance and ordinary axle grease, both in odour and physical qualities, and suggested that the composition of the lime was probably very similar to that of axle grease. He said that in applications to trees as against scale insects, and wherever applications were more generally made than by mere banding, the after effect on the tree would probably be disastrous, although it might not develop for some months. Experiments with other oils on trees gave a strong probability in this direction.

Mr. Smith said the insect limes would very probably turn out to be material similar to axle grease. The dendrolene referred to by him was a Standard Oil Company's product, and would very likely appear under different names as coming from different houses, although all would obtain their supply from the Standard Oil Company. As applied to old bark, which had no vital function, subsequent injury need not be feared.

Mr. Howard referred to the press reports of the loss by a Kentucky orchardist of a thousand valuable peach trees from the application of linseed oil, with other ingredients, as a preventive to the borer. The recommendation which led to the application was charged to the Department of Agriculture, this charge proving, however, by the man's own admission, to be unfounded.

Mr. Davis remarked that a similar remedy had been recommended by the United States Pomologist to the fruit growers of Michigan.

Mr. Smith called attention to the necessity, in reporting results, of giving adequate explanations, instancing the danger of confusion in the use of the term "emulsion" arising from the different kerosene emulsion formulas used as a case in point.

Mr. Forbush gave further results obtained by the commission in the use of lime against the gypsy moth and against the tent caterpillar, all indicating the value of lime. He also described the method of clearing out underbrush as a means of starving out the larvæ.

Mr. Howard said the starving-out plan was the one principally relied on in the work against the nun moth in Austria. Trees of considerable size were banded with the insect lime to prevent the ascent of the larvæ, and all low-growing vegetation was then absolutely destroyed and the larvæ perished for want of food. He further said that there are certain species of plant lice which descend the trunks of trees in autumn and ascend again in spring, against which bands of lime could be used to advantage. This would be particularly the case with the species common upon the tulip tree.

Mr. Lintner, referring to the difficulty of preparing a good emulsion, suggested the advisability of someone's undertaking the preparation of the emulsion as a merchantable article, spreading its benefits to the general public, who were not sufficiently skilled or equipped to undertake its home manufacture.

Mr. Smith said that some patented insecticides very closely imitated the kerosene emulsion, but were more expensive than their cost of manufacture warranted; but he agreed with Dr. Lintner as to the desirability of having the standard emulsion on sale.

Mr. Howard said that where an appropriation was available the superintendents of parks might make the emulsion and distribute it free of charge, as had been done in New Haven.

Mr. Southwick read a paper entitled "A City Entomologist and Insecticides."

The paper was discussed briefly by Messrs Smith and Howard.

Mr. Smith, discussing the work of Scolytus, stated that they normally attack weakened or unhealthy trees, and that a vigorous tree would require very considerable work by Scolytus to seriously injure it.

Mr. Lintner said he understood from Mr. Davis that the trees were thus diseased and unhealthy.

Mr. Davis replied that some of the trees were thrifty and others lacked vigour.

Mr. Rolfs referred to the great numbers of Scolytus which followed the disastrous frost of last winter in Florida, causing great alarm among fruit growers. He said, however, that the trees attacked were such as were greatly injured by the frost and would probably have died anyway from the effects of the latter, and that the beetles were always present though rarely injuriously abundant.

Mr. Howard said that it is well known that in the absence of sickly trees Scolytus will attack healthy and vigorous trees, and that the present large numbers of Scolytus are therefore a constant menace.

Mr. Smith said he had been informed by Mr. Schwartz that the beetles will enter healthy, vigorous trees, but are unable to successfully propagate in them.

Mr. Lintner said that Professor Peck had found them attacking perfectly healthy spruces.

Mr. Smith, referring to the climbing cut-worms, said that he had been frequently called on to determine for correspondents moths described as having been bred from climbing larvæ. He had received several such from Mr. Slingerland. He questioned if they did not adapt themselves to differing conditions, sometimes assuming the climbing habit, while perhaps normally working on the ground.

Mr. Howard reported that the species *subjuncta* and *scandens* had been repeatedly sent in this year as climbing cut-worms.

Mr. Sirrine asked if all cut-worms did not climb as young larvæ, giving his experience with cabbage cut-worms as sustaining that view.

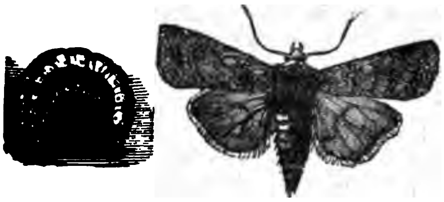

Fig. 34.

Mr. Smith said that this is the habit of *Carneades messoria* Fig. 34, on onions. In this connection he urged the value of personal observation to impress one with the true significance and importance of the working habits of insects. In illustration of this he referred to his having recently witnessed a grasshopper invasion in the west, which had brought to him a realization of the possibilities of this insect to which before he had been a stranger. He said also that the Hessian fly, commented on by Mr. Davis, had proved very much more numerous in New Jersey this year than in years recently passed.

Mr. Lintner said this fly was also very abundant in western New York.

Mr. Howard said this is distinctively a Hessian fly year, and that the division had recently issued a circular to facilitate answering the numerous inquiries received on the subject.

The following paper by Mr. Chittenden, was read by Mr. Sirrine:

Herbivorous Habits of Certain Dermestidæ.

The Dermestidæ, as is well known, feed chiefly upon dried animal substances. Certain species, however, are reported to have injured vegetable material, and a few recorded instances of damage of this character are cited. Until very recently the various species of household Dermestidæ had not been suspected of actually breeding in other than animal substances, but the experiments of the writer indicate that they subsist also on a vegetable diet.

The larva of *Attagenus piceus,* or black carpet beetle, was received in cereals from various sources, and was finally brought to the attention of the writer in such manner as to lead to a suspicion that it might feed, at least occasionally on vegetable substances. Adult insects were confined in a jar of flour and meal, and their progeny were found to thrive upon this material. This species was also found to breed in timothy seed, and incidental mention is made of serious injury to bolting cloth by it in a mill at Georgetown, D. C. A brief review of the history of this insect in America, where it has been known since about 1806, is given, and instances of its reported occurrences in granaries are citied.

Trogoderma tarsale Melsh., a common museum pest, was found to infest flaxseed, castor beans, and cayenne pepper that had been on exhibition in the museum of the United States Department of Agriculture, the larva being reared from the egg deposited in these substances and the adults having been bred from other larvæ feeding on them.

An unknown and evidently recently imported species of Trogoderma was stated to be living in flaxseed, castor beans, and silk worm cocoons with the above-mentioned species, and in red-clover seed. This species is believed to have been introduced at Washington in the silkworm cocoons. It has been taken in New Mexico and will probably be found to have established itself elsewhere in the United States.

Anthrenus verbasci Linn, our most abundant insect cabinet pest, was reported as occurring in "middlings" and spoiled flour, and the fact mentioned that at the time of writing larvæ placed in flour were feeding upon it, from which it was judged that they would in due time reach the adult condition.

In conclusion it is stated that in the case of the Attagenus and Anthrenus, these insects were probably first attracted to granaries by the presence of weevils and other grain insects, and that the graminivorous habit is an acquired one. The presence of Trogoderma in oil seeds and red pepper, however, admits of no other explanation than that of the absence of animal food, and shows a wonderful adaptability to unnatural environment.

Mr. Howard said that the buffalo moth does not occur in Washington, its place being taken by *Attagenus piceus.* He asked for the experience of others as to the former insect to determine its southern extension. *A piceus*, he said, is not so troublesome as the buffalo moth but is yet a serious pest. In answer to a query from Mr. Davis he gave a brief description of the larvæ of the two species.

Mr. Lintner, referring to the popular designation of the insect as the "buffalo moth," said that he had often urged the discontinuance of the use of this misnomer and thought an effort should be made to secure popular acceptance of a more appropriate common name for this species. He thought it not so strange that Dermestidæ fed on vegetable material, since many species having an altogether animal feeding habit in the larval state are vegetable feeders as adults, instancing the feeding of larvæ of various species on woollens and other animal products, the adults of which feed on pollen.

Mr. Fernald discussed the use against these insects of inflammable and explosive insecticides in connection with its bearing on insurance policies and was inclined on this latter account, not to recommend them. He gave the method of controlling the pest followed with success by his wife, as follows: (1) Before bringing flowers into the house thoroughly shake them to dislodge the beetles. (2) Regularly collect and destroy the beetles which emerge and gather on the windows of the house during the months of March and April. (3) Carefully treat the carpets on the upper floors of the house, as the beetles commonly enter through the upper windows, and these carpets act as traps, getting the first and the bulk of the invasion.

Mr. Davis said his wife had been unsuccessful in the use of similar remedies.

Mr. Rolfs said that the work of the carpet beetle was much worse in the South than in the North, but he did not know the species. He used carbon bisulphide or cyanide gas, preferring the latter. If used with caution he thought neither of these substances dangerous, and their use was especially desirable in connection with herbariums.

Mr. Lintner said that he ordinarily recommended kerosene, which he thought more suitable than gasoline. Before laying new carpets all the grooves should be carefully filled with cement or plaster, and the carpets should be left loose at the borders to facilitate frequent investigation. The use of tarred paper was also advisable. He had found the following trap method valuable; Remove all woollens from rooms or closets and scatter about them bits of red flannel, which is a very attractive bait for the Anthrenus. The beetles thus attracted are afterwards collected and destroyed. Referring to Mr. Fernald's statement regarding the method of entrance of the beetles from flowers out of doors, he said that this is a common experience and that they commonly enter houses through the upper windows and appear first in the carpets of the upper rooms, thus making their reappearance after having been exterminated.

Mr. Fernald discussed the subjects of the relation of colour in woollens or carpets to infestation by the buffalo moth, and said that it had been carefully investigated by his former assistant, Mr. Lounsbury, as to the attractiveness both of particular colours and different dyes to the beetles. The information was sought from various sources, including factories for the manufacture of carpets and rugs. The conclusion arrived at was that colour is not an important factor—at least the beetles do not confine their attacks to particular colours, though showing a preference for the greens. He thought it more likely that the preference exhibited by the beetles in certain cases was due rather to the mordant employed.

Mr. Howard said that the best remedy and the one which he now always advised, was to abandon the use of carpets altogether.

Mr. Smith had used the method suggested by Mr. Davis and had also employed gasoline. He had not found anything in insurance policies against the use of this or like substances in small quantities, but he was always careful to urge the greatest caution in the use of inflammable substances. He gave, by request, certain experiences which he had had with the use of bisulphide of carbon in the National Museum, a rather serious explosion having in one instance occurred from the ignition of this substance by the heat from a steam radiator, while there was another equally startling case of the ignition of the substance in a large box, resulting from a spark having been struck off from a nail in fastening down the lid of the box in which the bisulphide had been placed. In the latter case the box exploded and the negro laborer was either thrown a distance of some feet or had leaped a considerable length under the excitement of the moment.

Mr. Howard asked Mr. Taylor, a visitor present, who is engaged in the manufacture of bisulphide of carbon, if he knew of any cases of accident from the use of this substance.

Mr. Taylor replied that he knew of but one case of serious results, and that was where an explosion had resulted from a stroke of lightning. He was inclined to think that with ordinary precautions the danger was trifling. He said that the substance will ignite at 220° F.

Mr. Smith said that the radiator referred to by him was not nearly so hot as that.

WEDNESDAY MORNING—AUGUST 28th, 1895.

Mr. L. O. Howard read a very interesting paper on "Some Shade-tree Insects of Springfield and other New England Cities," in which he treated especially of the elm-leaf beetle (*Galerucella luteola*), and the Woolly Maple leaf Louse (*Pseudococcus aceris*), and traced their progress throughout the region referred to.

Mr. C. L. Marlatt followed with a paper on "The Elm-leaf Beetle in Washington," in which he described the methods pursued by the Division of Entomology to protect a grove of elm trees in the grounds of the Department of Agriculture from the ravages of this destructive insect.

Another paper descriptive of the history and injuries wrought by the same insect at Albany, N.Y., was read by Mr. J. A. Lintner, State Entomologist.

A long and interesting discussion followed in which most of the members present took part.

At the afternoon session Professor Fernald gave an extended account of the operations of the Gypsy Moth Commission in Massachusetts. (See 25th Annual Report, 1894, page 67, for a description of this insect, and the methods adopted to keep it in check.) In response to a request Mr. Kirkland, assistant entomologist to the Gypsy Moth Commission, gave a verbal report on the more recent experiments with insecticides conducted by the Commission. He said that no success had been had with insecticides until the arsenate of lead had been devised, and even this, at the rate of ten pounds to 150 gallons of water, effected the destruction of only about fifty per cent. of the larvæ. He described his examination of the alimentary canal of the larvæ, with a view to determining the probable action of the juices contained in various parts of the canal on insecticide substances. He had found the juices strongly alkaline, and of the substances which seemed most likely to be acted upon by an alkaline liquid he had considered the cyanides of different metals to be the most promising. The cyanides of lead, antimony, copper, zinc, n, manganese, mercury, etc., were considered. The cyanides of antimony and copper, theoretical grounds, seemed to promise best. The cyanide of antimony was totally thout effect at the rate of 10 pounds to 150 gallons of water. Cyanide of copper was rly effective, but too expensive for practical employment, three pounds to 150 gallons ing with this substance equivalent to one pound of Paris green to 150 gallons of water, three or four pounds of arsenate of lead to 100 gallons. Even where no practical ults seem to have been obtained, as in the above series of experiments, he pointed out value of the negative results ; in that the very fact that the merits of these substances luable for insecticides is better understood and limited. In connection with the vari- s experiments with insecticides he had occasion repeatedly to emphasize the extreme ality of the gypsy moth larva and its immunity to the action of poisons.

Mr. Riley discussed the gypsy moth question at considerable length. He said he had ways been much interested in the gypsy moth work, and referred to the orginal confer- ce called by the State Board of Agriculture of Massachusetts, giving an account of is meeting, and of the suggestions made by himself and others as to means of control- g the insect. These suggestions were necessarily based on experiences with our well own common insects having somewhat similar habits, and had no basis in any actual perience with the insect under discussion. He had recommended and believed that the of the arsenites is one of the most practical and effective means of control. There now be no doubt, however, that this insect is an exceptional one, and probably can t be controlled by means which are quite effective against other insects, enemies of our es, having similar habits. Emphasizing the great damage which may be done by this sect, he was convinced that its control and destruction are not only extremely necessary the State of Massachusetts, but are also of national importance. He had always been favor of extermination rather than of attempting to limit and control, but he pointed t the very great difficulty of exterminating the species if the work is mainly directed ward the destruction of the eggs, referring in this connection to his early statement in is regard, in which the destruction of the eggs had not been deemed of prime import- ce He thought, however, that in this particular he had been too extreme. He inted out the absolute futility of any efforts at extermination which did not promise mplete results. All that he had said in criticism of the Commission had been relative the operations prior to Professor Fernald's controlling connection with the work. He artily appreciated the value of the present methods as detailed by Professor Fernald. e felt that if at the outset a supreme effort had been made, with the aid of a very large propriation, complete extermination of the insect could have been accomplished. He ve a summary of some early work and his criticism of it. He was somewhat inclined question whether we are now justified in working on the basis of extermination through State commission, or whether it would not be better to encourage the efforts of private dividuals wherever the insect occurred, as is the case with other insect pests. He com- imented very highly, however, the present work of the Commission. In discussing the bject of parasites, which had been referred to by Mr. Fernald, he was not inclined to ree with the idea that the aim of the commisson at complete extermination detracted all from the necessity of undertaking the importation of foreign parasites. He said at such introduction could be accomplished at comparatively slight expense and would l just so much the object of the Commission, pointing out also the greater usefulness of ropean parasites over native ones if introduced without secondary parasites. This ould be particularly evident if his idea of the greater value of the destruction of the rvæ rather than the eggs were conceded.

In illustration of the great weight and value of Professor Riley's ideas on this sub- t, Mr. Fernald referred in the most complimentary way to the value of his long years labor in the field of economic entomology, which had resulted in a store of information ed and appreciated by all the workers of the world at the present day. He gave some atistics of the injury capable of being done by the gypsy moth in the State of Massa- usetts, basing his deductions on the value of farm products and the estimated value of rest and shade trees (Mr. Lintner interjecting in the latter connection that the Sara- ga elms were insured by the State at $500 each). Taking the probable injury from this moth as a basis, he pointed out that a comparatively trifling tax only would be necessary to raise a sum sufficient to control the pest, and was very strongly of the opinion that the work of the Commission should be upheld and continued.

Mr. Howard said he was familiar with the work of the Commission and had gone over the territory and examined the methods of procedure in detail somewhat recently, and was convinced that anyone, seeing the operations and the results already reached, would be impressed with the fact that the work is now being done in the best possible way and according to methods which are most likely to accomplish the ultimate extermination aimed at. He offered a resolution regarding the work of the Commission, which was subseqently acted upon by the Association.

Mr. Lintner said he had been one of the first called to inspect the work and the conditions of the work, and had been deeply impressed with the amount of exertion necessary and the difficulties of successfully prosecuting it. He also had been most favorably impressed with the value of the methods at present employed. Whether ultimate extermination would prevail or not was at present, of course, merely a matter of opinion, but he was convinced of the necessity of continuing the work on the basis of extermination rather than mere control.

The next paper was read by Mr. Lintner on the striped "Cottonwood Beetle" in which he drew attention to the threatened destruction of the basket-willow industry of Onondaga and some other counties of western New York, from the ravages of an insect which has long been known as the striped cottonwood beetle, *Lina scripta* Fabr., but which hitherto has not been regarded as injurious. After describing the insect and its habits, and giving an account of the willow industry and its commercial importance he related the methods which had been made use of to control the insect and especially drew attention to a mechanical contrivance, called a "bug catcher" which had proved very effective for the collection and destruction of the beetles.

Mr. Webster read a somewhat technical paper on the probable origin of the genus Diabrotica. This was followed by a paper by Mr. Hopkins of Morgantown, West Va

ON THE STUDY OF FOREST-TREE INSECTS.

The study of the insects affecting forest growth, from an economic standpoint, is in many respects a unique branch of economic entomology, which should in our opinion be designated by the term "forestry entomology."

The importance of advancement of knowledge in this particular branch of science may be inferred from some references to the character of insect injuries to forest growth; to estimates of the amount of damage and the annual pecuniary loss occasioned by such injuries; to the limited knowledge of this class of insects, and to the possibilities of preventing a large per cent. of the loss by the adoption of simple, practical methods of combating the pests.

CHARACTER OF INJURIES.

The injuries to forest growth may be separated into two classes, those affecting the living plants and those affecting the dead or dying plants. Of the former we have injuries to the foliage by leaf-eating, leaf-mining, sap-sucking, and gall-making insects; to the twigs and branches by sap-sucking, twig-mining, bark and wood boring insects; to the trunk by bark and wood-boring, and to the roots by wood-boring, bark-boring and sap sucking species; the effect of the injuries thus caused upon the living plant being either destructive or detrimental to its growth or usefulness.

The injuries of a destructive character are those caused by insects which occur in sufficient numbers and make their attack in such a manner as to destroy or weaken the vitality of the tree sufficient to be the prmiary cause of its death.

The injuries of a detrimental character are those which are detrimental to the health, perfect growth, or future usefulness of the tree or its product, but do not cause its death.

Of the injuries affecting the dying and dead trees we find, as among those affecting the living, some which are of a destructive character, while others are simply detrimental. The destructive injuries are those caused by wood-boring insects, which render the wood worthless for any practical use to man. The detrimental injuries are those which produce defects in the wood and hasten the decay of the affected parts.

CHARACTER AND EXTENT OF DAMAGE TO FORESTS BY INSECTS.

Few persons who have not given considerable thought to the subject realize the serious character of insect depradations upon our forests and forest products. This is evident from the fact that the subject is seldom discussed at the meetings of forestry associations and is rarely referred to by writers upon forestry economy in this country.

If we were to assert as our belief that the annual damage and loss occasioned by insects to owners of forest and forest products in the United States was greater than that caused to the same by fire, few persons, if any, would believe that it could be possible. Yet when we come to consider the varied losses resulting from insect depredation, both in a destructive and detrimental manner and in the general influence of their work upon the forest economy of the country, we believe that such an assertion would not be far from correct.

The pine and spruce killed by bark beetles over vast areas in New England and in the Southern States within the last few years has caused an enormous loss of valuable timber; yet this is only a small portion of the damage to timber by insects. That caused in oak by the oak timber worms (*Lymexylon sericeum* and *Eupsalis minuta*), the Columbian timber beetle (*Corthylus columbianus*) and the carpenter moths of the family Cossidæ, to the chestnut by the chestnut timber worm (*Lymexylon sericeum*), and to the tulip and other kinds of timber by the Columbian timber beetle, all of which attack living trees, will equal that caused by many forest conflagrations. Then when we come to consider the damage to the wood of dying, dead and felled timber, and the work of destruction only begun by fire and completed by wood-boring species, it appears to us that the damage caused by insects is at least equal to that caused by fire.

There is also another feature of the question, and that is in reference to the effect of the detrimental and destructive ravages of forest insects upon the forestry economy of the country. Owing to the large amount of timber destroyed and rendered defective by insects, it is necessary for the manufacturers to cut over a larger area than would otherwise be necessary in order to supply the demand for the best grades of lumber and other timber products. According to a statement by Hon. J. Sterling Morton at the last meeting of the American Association of Agricultural Colleges and Experiment Stations, the area cut over every day in this country to supply the demand for forest products is 30,000 acres. From our observation in the lumber regions of West Virginia it would indicate that at least ten per cent. less timber might be cut each year for this purpose were it not for the detrimental ravages of insects upon the standing and felled timber. Therefore, in this item alone the annual loss to the country and to the manufacturer is enormous, for it must be remembered that a large per cent. of the defective lumber is manufactured and disposed of at a loss to the manufacturer, and is often the cause of serious loss to the consumer.

No accurate estimates of the pecuniary losses caused by forest insects can be made. Yet with the knowledge gained on the subject from recent investigations of the ravages of forest tree insects, from correspondence with lumber manufacturers upon the subject, and reference to the statistics of forest products, we feel justified in presenting some figures which will at least indicate the extent of the loss.

We would estimate the loss caused by bark beetles of the family Scolytidæ, which have caused the death of pine and spruce trees over vast areas within the last ten years, at an average of $5,000,000 per year ; by bark and timber beetles of the Scolytidæ family causing defective wood in felled timber, $1,000,000, and by the same in timber injured by fires and other causes, $1,000,000 ; by the Columbian timber beetle to standing and living timbers, an average of $1,000,000 per year ; by the oak timber worms and the carpenter worms to the different species of oak, an average of $2,000,000 per year ; to chestnut timber by the chestnut timber worm, which is rendering one of the most valuable woods almost worthless, an average of $1,000,000 ; by wood borers of the family Cerambycidæ to standing timber injured by fire, $2,000,000 ; to felled timber and saw logs by the same kind of insect, $2,000,000 ; by other wood-infesting insects to standing and felled timber, $2,000,000 ; by foilage-infesting insects to living forest and shade trees, $3,000,000 ; by the white pine weevil, plant lice, scale insects, etc., to young forest growth, $1,000,000 ; by the powder-post beetles (Ptindæ) to forest products, such as seasoned handles, spokes, hoop-poles, building material, etc., $100,000, and by miscellaneous insects not included in the above estimates, $3,000,000—a total of $25,000,000 direct annual loss from insect ravages, which is without doubt a low estimate.

To the above could be added the loss to manufacturers in manufacturing and disposing of defective material, to consumers from the use of the same, and to the indirect loss to the country in the diminished forest area due to insect ravages ; all of which, could it be estimated in dollars and cents, would doubtless equal at least ten per cent. of the total value of the annual forest products of wood material in this country, or about $100,000,000 annually.

WITH FURTHER KNOWLEDGE ON THE SUBJECT MUCH OF THE LOSS CAN BE PREVENTED.

Probably one of the principal reasons why the economic study of forest insects has been neglected in this country is the prevalent belief that few, if any, practical methods can be found to prevent loss from their injuries. It is true the methods used to prevent loss from the attack of farm, garden, and fruit insects can not, as a rule, be successfully used against those affecting forest growth ; neither can many of the successful European methods of combating forest insects be adopted in this country. But there are simple, practical methods known which, if better understood by forest owners and manufacturers of forest products and properly applied by them, would prevent the annual loss of many millions of dollars' worth of timber.

Some of the results recently obtained and facts determined in the investigations now in progress in West Virginia in reference to the proper time to fell timber to prevent detrimental injury by insects, the utilization of defective material to the best advantage, and the introduction of predaceous and parasitic insects to prevent the undue increase of destructive species lead us to believe that many of the more serious troubles can be easily controlled when we learn more of the habits of the insects and the various conditions, favorable and unfavorable, for their development.

ADDITIONAL KNOWLEDGE AND MORE SPECIAL, ORIGINAL WORK NECESSARY.

Further original research and additional published knowledge are sadly needed in this branch of economic entomology. As compared with the knowledge of insects affecting other economic plants, scarcely anything is known of the life history and habits of even our commonest forest-tree insects. Consequently, the field for original work in forestry entomology is a broad one, rich in interesting material as well as in possibilities of important discoveries.

One of the most important aids toward advancement would be, in our opinion, carefully prepared monographs of the insects known to infest the different economic forest trees, on a similar plan to that adopted by Professor Forbes in his recently issued part of "A Monograph of insects injurious to Indian Corn."

Previous to the undertaking of work of this kind, however, further knowledge is necessary in reference to the food habits of the insects found upon or within the different host plants, and whether they are destructive, detrimental, beneficial, or neutral in their economic relation to the host. This important information can be best and most reliably supplied by specialists who are studying the different families of insects, and by those who will make a study of the food habits and life history of certain classes of insects which infest forest growth, such as foliage-infesting, bark-infesting, and wood-infesting insects, etc., as special lines of research.

If specialists in these various lines will keep in mind the importance of noting the host relations of the species they collect or observe on forest growth, and will publish the knowledge thus obtained, together with lists of species taken on the various economic forest trees, they will contribute valuable service to the country in the rapid advancement of forestry entomology.

Mr. Webster read the following paper:

THE IMPORTATION AND REPRESSION OF DESTRUCTIVE INSECTS.

By F. M. Webster, Wooster, Ohio.

In the year 1795 my topic would have sounded remarkably visionary and illogical; not that it was not known that destructive insects were being brought into this country from England and Europe, but that there should be any united action to prevent such importations, or to suppress them after being introduced, would heve sounded unreasonable and unpractical. But, come to think of it, can we name a single imported insect that has been repressed, or, in fact, has been seriously impeded in its diffusion over the country, by any systematic obstacles placed in its way by the action of man? Is it not nearer the truth to say that we have, as a people, assisted this sort of immigrants, both in reaching this country and in getting inland as fast as possible after they had landed? Our entomologists have increased in numbers and efficiency to deal with these pests, but I do not know of a single one that we have prevented from coming to this country or stamped out after it had reached here.* That we have and are saving the country millions of dollars annually by our advice and experiments I freely admit, but that is only a temporary relief, and by no means a protection against future depredations and losses. Now, there must be something the matter somewhere, and if not with the entomologists, as I feel that it certainly is not, then wherein lies the obstacle? Entomologists do not make the laws, nor are we always able to get those properly enforced that we do have; but that does not settle the problem. For my own part, I have very little faith in State laws, even if they could be enacted, and have often asked myself the question whether or not it was possible for a republican government, composed of minor governments, possibly, as in our case, numbering nearly half a hundred to protect its people from the immense losses occasioned yearly by destructive insects whose place of nativity is known to be thousands of miles away and across wide stretches of ocean which they could never have crossed unaided.

At present we seem unable to deal with the problem intelligently and practically, even within our own borders. We can not, as a people, protect ourselves from each other, much less from countries who very naturally have less regard for us than we have for ourselves. It was with such feelings that I watched the diffusion of the San Jose scale, even after it had been located. Here was a simple problem in national economic entomology, and the question appeared to me to be composed of two propositions, viz.: Could we do anything with it? and if so, what would be the importance of the entomologist in this transaction? We have been steadily gaining strength during the last quarter of a century, and I was a little desirous of seeing how powerful we were getting to be, how much we could do to stop the spread of this pest, as well as to effect its extermination where it had already gained a foot-hold. True, we had no laws to sustain us; but if we could but show the necessity for them we would have accomplished much, for, while the San Jose scale is the latest importation, it by no means follows that it will be the last. It is all right to study the biology of the insect, and this is really the first step to be taken, but the duty of the economic entomologist does not stop there by any means. The man who has been unfortunate enough to get the thing in his orchard wants to know all he can learn about it, but the one who is free of it would vastly more like to know how to keep free of it. Some of you are aware that I am not in the least in sympathy with the manner in which we have been dealing with this pest, or rather with those who have knowingly carelessly harbored it. I do not say this with a spirit of fault finding or criticism, but rather with the idea of improving upon the policy. I fully submit that it is not right to knowingly wreck the business of any nurseryman who is willing to do everything in his power to prevent distributing such a pest with his stock; but it seems to me that we commit even a greater mistake and do a more unjust act when we say that such a pest is in a certain locality, thereby throwing the onus on both the innocent and the guilty. This appears to me to be the very worst sort of an injustice, and places a premium on dishonesty. We should either give the name of the proprietor or else make no public statement whatever, giving him notice that any attempt to send out infested trees or plants will result in a prompt exposure and public condemnation.

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*See appended note at the end of this paper.

If I were to say that a member of this association was a murderer, it would reflect on the honour of all of us, and would serve to protect the guilty one from justice, provided there was such a one among us. Hereafter when we have to quarantine, let it be against individuals or firms and not against States or portions of States in which the innocent outnumber the guilty. We must use harsh and severe measures where such are necessary in order to be just to the deserving, but we have no right to make these deserving ones a partner in dishonesty with the unworthy and disreputable. To do this is but to place ourselves in a position where we are sure to be imposed upon by the latter and secure the merited distrust of the former. The people are coming to place some of their interests in our keeping, and if we would hold on to that confidence we must deal justly but firmly with those who threaten such interests, with the sole aim of profiting thereby. Even if entomologists were clothed with the right to enter into an agreement with nurserymen to keep the presence of a dangerous pest a secret from the public, which I strongly question, it is poor policy to do so. For a public servant to make private arrangements with those harboring public enemies is, generally speaking, a risky business and not usually conductive in elevation to the estimation of those whose esteem we can not well afford to ignore. There should be a discrimination between the deserving and the undeserving, but it should be extended and not promised, and even then with the understanding that it was entirely in the way of official assistance. If we follow the proper course, so as to merit the confidence of the people, the latter will be perfectly satisfied with the information that infected nurseries are under strict surveillance, and nothing infected will be allowed to go out; but let there be a few more revelations of the actions of some of these, such as we have seen within the last year, and people will naturally begin to speculate as to whom we are assisting and whose interests we are protecting.

I mention these things because I believe we can improve upon the policy that some of us have been following, largely by force of circumstances. What I would urge is this: First, a uniform policy to be followed as closely as our surroundings render possible by all of us; second, on the information of an infested nursery coming to us the proprietors are to be informed that no infested stock is to be sent out, and that they are to promptly go to work to stamp out the pest, and that any attempt to evade these rules will result in a prompt exposure. If it is known that their trade will not suffer if they choose to purchase their stock from uninfested localities until they have destroyed the pest on their own, most men will see at once that it is the least expensive way out of the trouble. I am satisfied that there is a method of procedure that will work the least hardship to the deserving, yet will compel the stubborn to keep infection confined to their own premises and stamp it out there as soon as possible. I believe that we hold the balance of power, so to speak, and need not barter our influence, but hold it to be sought for by those who wish to escape with the least trouble and loss If we are but just in our actions there will no trouble about the better class of nurseymen siding with us, and we shall have no difficulty in indicating the dividing line that separates the honorable from the dishonorable, and it will avail nothing for a belligerent firm to close their grounds and books against inspection and then demand our proof of infection. The very lack of proof of non-infection will be sufficient to fasten suspicion upon them.

I have noticed that the services of entomologists have been quite in demand during the last year by nurseymen who were free of the San Jose scale, and the statements of such entomologists were used in the advertisements of these firms; and I think the influence of Dr. Lintner and myself has been felt by at least two nursery firms when it came to the question as to whether they could continue to impose on the public or not. Now, while, as I stated, we have no laws to sustain us, we have a strong public sentiment in our favour, quite sufficient to influence the honorable to favour our plans, and the others we can whip into line, so to speak, by working on their interests. While we have not come out of this contest just in the shape that I wish we had, we have certainly placed our profession on a better footing and shown that we have a power to do for right and justice; that we can help the deserving and at the same time deal firmly and judiciously with the undeserving and disreputable; and so long as we are faithful to our trust we shall be able not only to hold our influence but greatly increase the same.

I confidently look for considerable aid from nurseymen themselves in the matter of preventing the distributing of orchard pests. The most pushing and energetic are beginning to see that it will pay to spray their trees year after year in the nursery row with both insecticides and fungicides; that by so doing they will get a better growth and consequently a larger number of first-class trees that will bring a better return for use of their land and labour. Now, these are not likely to be so blind as not to see that to be able to warrant their stock free from insect and fungus enemies will give them a prestige, and they will thus guarantee every bundle of stock that is shipped from their grounds. When we reach this stage of advancement it will be a small matter to get a United States law that will make this a condition of acceptance for transportation by the railway and express companies.

In the past our advice and cautions have been more or less ignored, but I think if a nurseryman were about to import trees or bring them from California he would think of consulting the United States entomologist in regard to the risk he would run with respect to injurious insects. And there is little doubt that there will be much more caution exercised in future than there has been in the past, and the next new thing we get we shall be better prepared to exert our power and influence than we were in this case. I am satisfied that the San Jose scale can be stamped out where it has been introduced, at least between the Rocky and Alleghany mountains. East of this area it will have to be exterminated or else many nurseries will be compelled to suspend business for lack of customers, and they are not going to do this in the near future. We have done well this time, but we will do better in the future.

NOTE.—The fluted scale of the orange (*Icerya purchasi*), though it has been subjugated in California, at a saving of thousands, if not, indeed, millions, of dollars (and the importation of the natural enemies whereby this was accomplished was the greatest achievement ever attained in practical entomology), still it has yet to be exterminated. So of the gypsy moth (*Ocneria dispar*), introduced into Massachusetts by a lamentable piece of carelessness on the part of an entomologist many years ago, while it has been overcome in some localities, it has not been exterminated. I am free to confess that up to the time of presenting this paper I had very serious doubts as to the possibility of this ever being done; not because of any fault or neglect among those intrusted with the work, but because it appeared to me that they had attempted an impossibility. I have since spent a day in examining the work in all of its details, and believe that I saw not only what had been done, but also what yet remained to be accomplished; and that, too, with unprejudiced eyes and mind, and in company with one who clearly had no other motive than to show me every feature precisely as it existed, without magnifying, minifying or concealing anything. I now feel confident that the question of the extermination of this pest in Massachusetts is simply one dependent upon the support in future given those in charge of the work; that with proper support financially this pest will be absolutely wiped out of existence in America, and that the achievement will be the greatest yet attained, and one of which we shall all feel proud, while it will redound to the credit of economic entomology all over the civilized world.

F. M. W.

Mr. Fernald asked if anyone was aware of wilful and malicious importations of injurious insects from Europe, referring in this connection to the report of the possible transportation of certain American insect pests in the opposite direction. He was himself aware of no such cases.

Mr. Smith said the only case known to him was the importation of the Ailanthus silkworm.

Mr. Sirrine, referring to Mr. Webster's communication, said that he had found about the 1st of July instances of the purchase of apple trees badly infested with living San Jose scale, which had supposedly been effectually treated before being sold and sent out.

Mr. Smith said that he was aware that these trees had been treated with gas during the winter, and described the methods which had been followed. In the examination made by himself he had found no living scales, but undoubtedly some living specimens had been left, and probably from these the trees had become re-stocked. He pointed out the necessity of examining every scale before it was possible safely to pronounce stock immune, and therefore the impracticability of giving any such indorsement to nurseries.

Mr. Riley emphasized the extreme difficulty and great liability to error on the part of entomologists should they follow the plan of pronouncing any particular nursery free from scale. In some cases circumstances may warrant such an indorsement, especially if there is reason to believe that the insect in question is recently introduced and therefore confined to a restricted area or single point of infestation, as seemed, indeed, to be the case in the first discovery of the San Jose scale in the east. In such cases it may not be necessary to give publicity to the point of infestation if proper measures are being taken to suppress the insect. It was on this basis that he acted in the case of the San Jose scale; but when an insect is known to be widely disseminated a full public statement of the extent of the infested locality is desirable.

Mr. Smith agreed with Mr. Riley as to the difficulty of pronouncing any nursery untainted, and had decided for himself not to give clean bills of health to any nurseries in future.

Mr. Southwick read a paper entitled "Economic Entonomological Work in the Parks of New York City."

Mr. Webster read a paper on the "Insects of the year in Ohio." The time available for the reading of papers having expired, the three following, whose authors were absent, were read by title only, viz.:—"On the Natural Conditions which Affect the Distribution and Abundance of Coccidæ," by T. D. A. Cockerell, Las Cruces, N. Mex.; "How shall we Improve our Collections?" by C. P. Gillette, Fort Collins, Colorado; and "Carbon Bisulphide for Crayfish," by H. E. Weed, Agricultural College, Miss.

The following resolution relative to the Gypsy Moth Commission, introduced by Mr. Howard, was now brought up and received the unanimous indorsement of the Association:

Resolved, That it is the sense of this Association that the present Gypsy Moth Commission is prosecuting its work in the most intelligent and praiseworthy manner, and that its hands should be upheld by the State authorities.

Mr. Lintner presented the following resolution, which was also unanimously adopted:

Resolved, That this Association has learned with deep regret of the intended discontinuance of *Insect Life* with the present number. In consideration of the unusual value of this publication, the eminent ability with which it has been conducted, the high appreciation in which it has been held by all of our entomologists and those in other countries, and the importance of the published investigations into the life history of insects, largely on their economic aspect, this Association earnestly requests of the Department of Agriculture that the resumption of the publication of this invaluable publication may be directed at no [illegible]t day.

The Committee on Nominations, consisting of Messrs. Lintner, Davis and Rolfs, proposed :

For *President*, C. H. FERNALD, of Amherst, Mass.
For *First Vice-President*, F. M. WEBSTER, of Wooster, Ohio.
For *Second Vice President*, HERBERT OSBORN, of Ames, Iowa.
For *Secretary*, C. L. MARLATT, of Washington, D. C.

On motion, the chair was instructed to cast the ballot of the Association for the gentlemen named, and they were declared duly elected.

On motion of Mr. Southwick, the reading of the minutes of the entire meeting was dispensed with, and on motion of the same gentleman a vote of thanks was tendered the President and Secretary of the Association in recognition of their services.

On motion of Mr. Howard, the local committee in charge of the meeting at Springfield was given a vote of thanks.

President-elect Fernald took the chair and briefly expressed his thanks for the honour conferred upon him.

The Association then adjourned.

WILLIAM H. EDWARDS.

Our readers will all, we are sure, be glad to receive the excellent portrait prefixed to this volume of the well-known and now venerable entomologist, Mr. W. H. EDWARDS, of Coalburgh, West Virginia. His life-long work has been the study of diurnal lepidoptera, and the results of that work are splendidly set forth in the beautifully illustrated volumes of his "Butterflies of North America." In April, 1868, the first part was issued, and at once commended itself to entomologists everywhere by the exquisite beauty and finish of the plates and their faithfulness to nature. In July, 1872, the first series, forming a large quarto volume with fifty plates, was completed. The second series, containing fifty-one plates, was begun in May, 1874, but not finished until November, 1884; the less frequent issue of the parts being more than compensated for by the increased value of both plates and letter press. When the work was begun, as Mr. Edwards stated in his preface, little or nothing was known of the eggs, larvæ, or chrysalids of any except the commonest butterflies, and accordingly his first volume illustrated only the perfect state. In 1870 he made the notable discovery that eggs could be satisfactorily obtained by confining the female butterfly of any species with the growing food-plant of its larva, and at once began the study of the life-histories of a number of species previously known only in the imago state. The results of these studies are admirably set forth in the letter press as well as in the plates of the second and third series ; on these are accurately depicted eggs and larvæ in their different stages, as well as chrysalids and imagoes. Many wonderful discoveries have been made during these investigations, among the first being that of the seasonal trimorphism of *Papilio Ajax* and the dimorphism of *Grapta interrogationis* and of *G. comma*. The process of breeding was soon taken up by Mr. Edwards's friends and correspondents all over North America, and, aided by the general extension of railways over the continent, he was able to get eggs of butterflies from widely distant localities, and to follow them successfully through all their stages. Thanks to his efforts the reproach of ignorance of the preparatory states of our butterflies has been removed, and though much remains to be learnt, vast progress has already been made. The first part of the third series was issued in December, 1886, and in October last we had the pleasure of welcoming the sixteenth. Far from showing any decline from the author's high standard of excellence, this last issue may justly be regarded as the climax of good work, both on the part of the writer and the artist. All through Mr. Edwards has been fortunate in having his wishes so ably carried out by his artist-assistants—Mrs. Mary Peart, of Philadelphia, who has drawn most accurately nearly all the plates, and in order to do so satisfactorily has reared most of the caterpillars; and Mrs. Lydia Bowen who has so exquisitely performed the work of colouring. Many of the plates of the third series have been drawn by Mr. Edward A. Kellner, of Philadelphia.

In addition to the great work that we have just referred to, Mr. Edwards has contributed largely to the periodical literature of the science, especially to the proceedings and transactions of the American Entomological Society and to the *Canadian Entomologist.* His first contribution to its pages was published in the third number of the first volume, in 1868, and he has continued to favour it with articles of great value ever since, his last paper, in the September number of volume xxvii., being the one hundred and sixty-eighth which he has written for our journal.

Mr. Edwards was born on the 15th of March, 1822, and will soon complete his seventy-fourth year. That he may long be spared in health and prosperity to carry on his excellent work is the cordial wish of the writer and all his friends.—C. J. S. B.

BOOK NOTICES.

THE BUTTERFLIES OF NORTH AMERICA, with coloured drawings and descriptions, by W. H. Edwards. Third series, part xvi. Houghton, Mifflin & Co., The Riverside Press, Cambridge, Mass.

Though nearly a twelvemonth has gone by since the preceding part was issued, we could well afford to wait with patience for another number, when our author rewards us with so much that is remarkably interesting as well as valuable regarding the life-histories of some hitherto little known butterflies.

The first plate, which as usual is exquisitely drawn and coloured, depicts the female of *Parnassius smintheus*, Doubl.Hew., and both sexes of the variety *Hermodur*, H. F. Edw., together with the egg, larva in all its stages, chrysalis, last segments of the male butterfly, and many highly magnified details. After giving a description of the various stages of the insect, the author relates many most interesting facts regarding the life and habits of the butterfly, which have taken expert observers in the States of Colorado, Montana and Washington no less than twenty years to accumulate! The account is concluded with a description of the formation of the extraordinary pouch or keel which is to be seen beneath the abdomen of the females of various species of Parnassius. That this should be formed by the male is one of those strange marvels that render the careful study of the lives of our butterflies so interesting and attractive.

The second plate depicts both sexes of *Satyrus Charon* and the male of its variety *Silvestris;* also the egg, the various stages of the larva, the chrysalis, and many details. The imago and the several preparatory stages are described, and a short but interesting account is given of the habits of the butterfly and the rearing of the larvæ.

On the remaining plate are figured the egg, three stages of the larva with details, and both sexes of the imago of the British Columbian species (*Chionobas gigas*), Butler. After describing the preparatory stages so far as known, the author relates the differences in appearance and habitat between this species and *Californica* and *Iduna*, which are frequently confused in collections. *Gigas* is shown to be confined, so far as is yet known, to Vancouver Island, where the male frequents the tops of the highest mountains, the female being usually found much lower down ; *Iduna* inhabits the slopes of the evergreen red-wood forest in north-eastern California on the Pacific coast ; and *Californica*, the hot arid regions of east Oregon, Washington and the semi-desert portion of north-east California. "*Gigas* is semi-Arctic, living amid the cold, dark fir forest ; *Iduna* is temperate, living in the mild, dark red-wood forest ; *Californica* is semi-tropical, living in open, dry, warm glades in the "bushland" on the border between the forest and the open plains. *Gigas* alights on bare rocks ; *Iduna* on green twigs ; *Californica* on dead or dry grass." But we must refer the reader to the book itself for all the interesting particulars regarding these strange butterflies.

The wonder to us is that so few entomologists subscribe to this magnificent work. The parts are issued at such long intervals that the cost is very light ; those who have secured them know what a treasure they possess and how highly they prize it.—C. J. S B.

THE NATURAL HISTORY OF AQUATIC INSECTS, by Prof. L. C. Miall, F. R. S. London and New York, MacMillan & Co. (66 Fifth avenue, N. Y.; price, $1.75), pp. 395.

This interesting work is intended, as the author states, "to help those naturalists who take delight in observing the structure and habits of living animals," and also to revive an interest in the writings of some of the old zoologists who did notable work in their day, but who are now almost forgotten, namely, Lyonnet, Réaumur, Swammerdam and De Geer, of whose lives and work he gives a short account.

To any lover of nature who wishes to look into the lives and doings of living creatures, and to investigate their structure and appliances for carrying on the business of their lives, this book will prove a very great help as well as an unfailing pleasure, and it ought to lead many a reader to explore for himself the ponds and pools in his own neighborhood which teem with insect life. The different groups of insects that live in the water in their larval or perfect states, are treated of in turn—water beetles and the larvæ of many flies, the caterpillars of some moths, caddis worms, May flies, alder flies (Sialidæ), stone flies (Perlidæ), dragon flies, pond skaters, water boatmen, etc. The very names of these insects bring to mind what one cannot fail to have seen and watched and wondered over. To have many of these wonders explained and described, and to have the insects themselves depicted and the peculiarities of their structure made clear by excellent woodcuts, is what we owe to the author of this book, and we hope that many will turn to its pages with profit and delight. It is a handsome volume, with clear, large type and a number of very good illustrations.—C. J. S. B.

The Cambridge Natural History, Vol. V. Peripatus, by Adam Sedgwick, M.A., F. R.S.C.; Myriapods, by F. G. Sinclair, M.A.; Insects, (Part 1) by David Sharp, M.A., F.R.S. London and New York, MacMillan & Co.

The possession of some such work as this is of primary importance to the student in any department of zoology, to enable him to obtain, and have at hand for reference, a general knowledge of the varied groups into which, for convenience of study and classification, the animal kingdom is divided. In every home that can afford the luxury of books it will also be found most valuable, affording a continual fund of instruction, and implanting in the children a spirit of inquiry, and of interest in the many wonders of nature. It is only about ten years since the publication, in six sumptuous quarto volumes, of the Standard Natural History, edited by Prof. Kingsley, and having as contributors many of the most eminent scientific men of America. To a certain extent their references and illustrations were more largely drawn from the fauna of our own continent, although a work of this general character must not be expected to be in any way restricted in its choice of examples of any group. Our knowledge of the animal kingdom is, however, so constantly being enlarged by the labours of an ever increasing and better equipped body of investigators, that the present work will be found to be considerably in advance of any previous publication. The editors are S. F. Harmer, M.A., Superintendent of the Cambridge University Museum of Zoology, and A. E. Shipley, M.A., University lecturer on the Morphology of Invertebrates. These names, and those of the authors of the various memoirs, are a guarantee as to the accuracy and completeness of the work, and of its fitness either for the private student or for the teacher of zoology. When finished it will consist of ten handsome large octavo volumes, which will form a desirable addition to any library.

Mr. Sedgwick's memoir on Peripatus indicates at once the marked advance that has been made in some directions of biological research. In the Standard Natural History, where it is placed as a sub-class—Malacopoda—of the insects, this curious genus occupies scarcely more than a page, for the knowledge of it was than very fragmentary. Mr. Sedgwick, whose studies of the genus have been very extended, and who has written previous monographs, gives a very interesting account not only of the outward appearance of this very peculiar creature, but also of its embryology, development and habits. There are numerous illustrations and a map showing the distribution, which extends through portions of South Africa, Australia, New Zealand, South and Central America and the West

Indies. Described by its discoverer, (Rev. L. Guilding), as a mollusc, from its slug-like form, this unique animal is now found to belong to the arthropods, although possessing features not belonging to other members of that division. Indeed it is said to "stand absolutely alone as a kind of half-way animal between the Arthropoda and the Annelida." As a very primitive type, exhibiting affinities to both groups, it possesses a special interest to zoologists. The species are few in number, and are of elongated slug-like shape, with from seventeen to thirty-four pairs of legs; subsisting upon animal food and shunning the light.

The Myriapoda are stated by Mr. Sinclair in his introduction, "not to have attracted much notice until comparatively recent times. Compared with insects they have been but little known. The reason of this is not hard to find. The Myriapods do not exercise so much direct influence on human affairs as do some other classes of animals; for instance, insects. They include no species which is of direct use to man, like the silk-worm or the cochineal insect, and they are of no use to him as food." To the farmer's crops, however, some species, known as wire-worms, (Iulus) do considerable damage, while many of the carnivorous species must, on the other hand, be of considerable assistance in destroying injurious insects. Myriapods are those elongate, many-footed creatures, lurking under rubbish and in dark places, which are usually called centipedes and millepedes. Regarded with distrust on account of the venomous bite of some of the large tropical species, their appearance and habits of concealment produce in most people a decided aversion to more intimate acquaintance. The author, however, gives a very pleasing summary of their habits, and proves that a study of these creatures, as is true of all forms of life, however repellant to the ordinary observer, is far from being devoid of interest. Our popular names are not sustained on closer examination, for none of the species have nearly a thousand legs, and a large proportion have far less than one hundred. The number varies from nine pairs in the tiny Pauropus, to about one hundred and seventy pairs in some species of Notophilus. The Myriapods have many affinities to the insects, and have been classed with them by many authors. They differ from insects, as well as from the other classes of arthropods, in having true, jointed legs on the posterior segments of the body. Mr. Sinclair recognizes five orders, the species of which vary in length from the one twenty-fifth of an inch (Pauropus) to almost a foot, as in the tropical centipedes. He does not mention, however, perhaps because it is now extinct, the great centipede, described in the Japanese tale of My Lord Bag-of-Rice, which inhabited Mukade-yama (Centipede Mountain) on the shores of Lake Biwa, and which was over a mile long, with exactly one thousand feet on each side of its body. Some of the forms, as Glomeris, are quite short and stout; others, as Iulus, have long cylindrical bodies; while Notophilus and Geophilus have the body very thin and elongated.

Eighty pages are occupied by these interesting memoirs on Peripatus and the Myriapoda, and in the third chapter Dr. Sharp introduces the Insects, and continues their discussion throughout the remaining five hundred pages, in a style that proves him a master of the subject, and also of its presentation to his readers. Naturally, as an Entomological Society, we take a closer interest in this great class, into which are grouped an immense assemblage of small creatures, varying to a wonderful degree in structure and habits, yet having, amidst all this diversity, well-marked relations to one another. To use the author's opening words "Insects form by far the larger part of the land animals of the world; they outnumber in species all the other terrestrial animals together, while compared with the vertebrates, their numbers are simply enormous. * * * * The largest insects scarcely exceed in bulk a mouse or a wren, while the smallest are almost or quite imperceptible to the naked eye, and yet the larger part of the animal matter existing on the lands of the globe is in all probability locked up in the forms of insects. Taken as a whole they are the most successful of all the forms of terrestrial animals. In the waters of the globe the predominance of insect life disappears. In the smaller collections of water many insects find a home during a portion of their lives, and some few contrive to pass their whole existence in such places; but of larger bodies of water they invade merely the fringes, and they make only the feeblest attempt at existence in the ocean."

A not infrequent question is "What is an Insect?" and for the benefit of many who have not opportunity to study entomology, yet to whom some knowledge of the subject is important, it may be answered by the author's brief and clear definition of the class Insecta; or Insecta Hexapoda.

"Insects are small animals, having the body divided into three regions placed in longitudinal succession, head, thorax and abdomen: they take in air by means of tracheæ, a system of tubes distributed throughout the body, and opening externally by means of orifices placed at the sides of the body. They have six legs and a pair of antennæ; these latter are placed on the head, while the legs are attached to the thorax, or second of the three great body divisions; the abdomen has no true legs, but not infrequently has terminal appendages and, on the under surface, protuberances which serve as feet. Very frequently there are two pairs of wings, sometimes only one pair, in other cases none; the wings are always placed on the thorax. Insects are transversely segmented—that is to say, the body has the form of a succession of rings; but this condition is in many cases obscure; the number of these rings rarely, if ever, exceeds thirteen in addition to the head and to a terminal piece that sometimes exists. Insects usually change much in appearance in the course of their growth, the annulose or ringed condition being most evident in the early part of the individual's life. The legs are usually elongate and apparently jointed, but in the immature condition may be altogether absent, or very short; in the latter case the jointing is obscure. The number of jointed legs is always six."

The amplification of this definition and the exposition of the external and internal structure, and of the functions of the various organs, occupy two chapters. Referring to Parthenogenesis, or "the production of young without the concurrence of the male," which sometimes occurs, the remarkable fact is noted that in a few species of saw-flies, gall-flies and scale-insects no male is known, so that they must be considered as perpetually parthenogenetic. The next chapter gives a valuable summary of the embryology and metamorphoses. While the vast majority of insects are oviparous, the eggs deposited varying greatly in number, size and shape, a few species bring forth living young, as in the Aphididæ (green-fly or plant-lice), which thus multiply with extraordinary rapidity. A brief chapter follows on the classification, and it can readily be understood that diversity of opinion has existed, and may long continue, as to the most satisfactory arrangement of the vast hosts of insects. As some 250,000 species have already been described, and several times that number undoubtedly exist, any scheme of classification must, under our present knowledge, fail to adequately provide for the reception of every form. Dr. Sharp points out that owing to the present limited knowledge of the earlier stages of insects, the only complete system of classification yet possible must be based upon the structure of the adult forms. It is noted with pleasure that he does not consider it necessary to make so many orders or primary divisions as has been the tendency of recent authors. Instead of twenty, as recently proposed by Packard, he limits them, much to the advantage of the ordinary student, to nine, viz., Aptera, Orthoptera, Neuroptera, Hymenoptera, Coleoptera, Lepidoptera, Diptera, Thysanoptera, and Hemiptera.

The Aptera are designated as "small insects, with weak outer skin, destitute throughout life of wings or their rudiments, but with three pairs of legs; antennæ large or moderate in size." It is pointed out however that this definition does not clearly differentiate them from many of the young individuals of other orders, and that the order does not, as its name might indicate, include all wingless insects. Two sub-orders are present: Thysanura, with the abdomen composed of ten segments, and Collembola, of not more than six. The study of these insects is attended with more than ordinary difficulty, as their habits and fragile structure make them troublesome to collect and preserve. Campodea, supposed by many authors to represent one of the most primitive types of insect, and therefore of unusual interest, is said to be "so extremely delicate that it is difficult to pick it up, even with a camel's hair brush, without breaking it" The Collembola are the "Spring-tails," two of the three families having the abdomen provided with a leaping apparatus which enables them to jump about in a very vigorous and erratic way. The Aptera are supposed to feed upon vegetable and animal refuse, and can endure both heat and cold, but require moisture, so that they occur most abundantly in cellars, under rubbish, in mosses, and other damp situations.

The Orthoptera form one of the most important orders of insects, both as regards the diversity of structure exhibited, the great size of many species, and the enormous devastation often wrought by their innumerable swarms. Dr. Sharp occupies nearly one hundred and fifty pages with his synopsis of the order, and his admirably written and illustrated account of the various groups should awakon, in all who are fortunate enough to read it, a lively interest in the insect world. He estimates that the order contains, at the lowest figure, 10,000 species, and treats it as composed of eight families. Of these the first is the Forficulidæ, or earwigs; elongate insects, having the abdomen terminated by a pair of clasper-like instruments, often greatly developed. Many of the forms are wingless, and those provided with wings are able to completely fold them up and tuck them under short wing covers, so that they have considerable resemblance to some beetles of the family Staphylinidæ. In Canada earwigs are poorly represented, and the one little species of Labia found in Ontario is but rarely met with. The family Hemimeridæ contains a few small, wingless, blind insects from equatorial Africa, interesting as occurring on small mammals either as parasites or commensals. The Blattidæ, or cockroaches, are both destructive and unpleasant creatures, although some forms are brightly coloured. Canada is not much troubled with these creatures, although a few disagreeable species have been introduced, but in warmer climates they are often veritable plagues. The Mantidæ, or praying insects, are wanting in our fauna, but in tropical and sub-tropical regions the species are numerous and their bodies are often strangely developed; sometimes by leaf-like expansions, serving to make them inconspicuous among the foliage in which they lurk. These developments of structure are even more marked in the Phasmidæ—stick and leaf insects—as shown by the figures of various genera.

The family Acridiidæ contains those very prolific and voracious vegetarians, the locusts and grasshoppers. These breed so rapidly and appear in such enormous swarms as to make less incredible, than it might at first appear, the author's statement, previously quoted, as to the relative bulk of insects and other terrestrial animals. The migratory locusts at times destroy all vegetation over large areas, and may thus produce famine and disease. As Dr. Sharp says, "It is difficult for those who have not witnessed a serious invasion to realize the magnitude of the event. Large swarms consist of an almost incalculable number of individuals. A writer in *Nature* states that a flight of locusts that passed over the Red Sea in November, 1889, was 2,000 square miles in extent, and he estimates its weight at 42,850 millions of tons, each locust weighing one-sixteenth of an ounce. A second similar, perhaps even larger, flight was seen passing in the same direction the next day." The Locustidæ, or green grasshoppers, are more arboreal in their habits, and often have the wings of a very leaf-like appearance. They are also more musical, and capable of strong and sustained performances. The well known American Katydids belong to this family. The last family, Gryllidæ, contains the crickets, whose concerts enliven the summer evenings. The fossorial, or mole crickets, have the front legs most admirably adapted for burrowing.

The treatment of the Neuroptera occupies an equal space and is no less interesting. The first family, Mallophaga, contains the biting or bird lice, so troublesome to birds and mammals. The Termitidæ, or white ants, are one of the most wonderful of all the groups of insects, and the individuals are strangely modified to fit them for their duties in the communities of which they are members. A table is given which shows that as many as fifteen distinct forms may occur (as in *Termes lucifugus*), and many of these may co-exist in the community, while others are only produced as necessity demands. The African species are the most remarkable, *T. bellicosus* forming solid mounds as much as twenty feet high. To sustain the population of these immense colonies, the queen becomes a marvellous egg-producing machine. "Twenty or thirty thousand times the bulk of a labourer," she is unceasingly fed by a band of workers, and as unceasingly gives forth eggs, to the number even of "eighty thousand and upward in one day of twenty-four hours." To the Neuroptera belong also the ant-lions, dragon-flies and other well known insects. A large proportion are aquatic in their earlier stages, and most interesting in their habits, either as residents of the water or the air.

The last one hundred pages of Dr. Sharp's charming portrayal of the insect world is devoted to a portion of the Hymenoptera, the species of which are estimated at 250,000. This order contains, among its almost inexhaustible forms, those which are of exceptional interest, from the intelligence which governs their actions. Dr. Sharp has called attention to an error which has occurred through hasty writing of the explanation of the anatomy of *Sphex chrysis* (page 490, Fig. 333), where the letter *f* is called a division of the metanotum, whereas it really belongs to the mesonotum. This error will be corrected in the portion dealing with the Aculeata The present volume only treats of the Sessiliventres, those in which the abdomen is broadly and closely joined to the thorax, and the parasitic families of the Petiolata, in which the abdomen is attached by a petiole, or stalk, often remarkably slender and prolonged. The first division includes the sawflies, of which the caterpillar-like larvæ are so injurious to vegetation, and the horntails, whose larvæ bore in the trunks of trees. The parasitic families exhibit much more variety of structure, and the species, even in our northern fauna, are exceedingly numerous. They vary in size; some Pimplids measuring several inches from the head to the tip of the very long ovipositor, while among the Proctotrypids and Chalcids are forms almost invisible to the naked eye. Dr. Sharp clearly tabulates the conditions under which the early life of such parasites is passed.

"1. The egg may be laid outside a larva, and the embryonic and larval developments may both be passed on the exterior.

2. The egg may be laid and the embryonic development passed through, outside the host, but the parasite on hatching may enter the host, so that the post-embryonic development is passed in the lymph of the host.

3. The egg may be laid inside the host, both embryonic and post-embryonic developments being gone through in the fluids of the host.

4. The egg may be laid inside another egg, the embryonic and post-embryonic developments being passed therein."

A large section of the Cynipidæ are not parasitic, but subsist upon plant tissues, producing swellings and distortions, known as galls, in which the larvæ live and develop. Among the illustrations of the hymenoptera are excellent figures of four insects occurring in Ontario and other portions of Canada, viz., *Oryssus Sayi*, *Tremex Columba*, *Thalessa lunator* and *Pelecinus polyturator*, the last three being quite common insects. The illustrations throughout the volume, 371 in all, are both accurate and artistic, and many have been specially drawn for the work. The paper and press work are of the best, and the result is a very handsome volume. The appearance of the next volume, completing this most valuable and enjoyable account of the insects, will be eagerly awaited.

W. Hague Harrington.

Rambles in Alpine Valleys, by J. W. Tutt, F.E.S.; 208 pages, five plates
London: Swan, Sonnenschien & Co.

The Editor of *The Entomologists' Record and Journal of Variation* has added another to his popular books on the beauties of nature. This time he takes the reader abroad to the lovely scenery of Switzerland on the Italian slopes of Mont Blanc, where he wanders for the most part out of the beaten track of the ordinary tourist. Much of the volume is filled with charming pen-pictures of the infinite variety of grandeur and beauty to be found among the lofty mountain tops, the towering crags, the densely wooded ravines and the dashing torrents of this secluded Alpine region. The eye of the naturalist does not fail to observe the marvellous variety of animal and vegetable life that is to be found in this limited area; and the author describes many a plant and flower, and especially the gay butterflies and pretty moths with which the region abounds. Some of the most interesting passages are those that deal with the phenomena of variation caused by environment, the results of the glacial epoch in the distribution of species, the effect of altitude on plants and insects, the evolution of the genus *Colias*, the production of colours, the causes of hybernation, and other topics which arise from time to time as the author rambles through the valleys or climbs the Alpine hills. The perusal of such a book as this must help the reader to see and observe, and lead him on to think out for himself the causes and the objects of the life that everywhere surrounds him.—C. J. S. B.

A MANUAL FOR THE STUDY OF INSECTS, by John Henry Comstock and Anna Botsford Comstock; Ithaca, N.Y. Comstock Publishing Co., 1895.

This is a work of 700 pages, profusely illustrated. A table of the classes of the Arthropoda is given, followed by a short characterization of the Crustacea. Thirty-three pages are devoted to the Arachnida, and a table is given for separating the principal families of the Araneida. The Myriapoda are briefly referred to, and chapter iii. begins the discussion of the true insects (Hexapoda). Nineteen orders are recognized, and a careful table is given for their practical determination.

In the remainder of the work, 618 pp., the several orders are treated with tables carrying the student to the families, each illustrated by typical common species, of which brief accounts are given.

In the lepidoptera, diptera and hymenoptera, the uniform system of nomenclature of the wing veins discussed by Prof. Comstock in "Evolution and Taxonomy" is applied throughout the orders. As stated in the preface, but slight changes are made from the usual classification of the families, except in the lepidoptera where the system proposed in "Evolution and Taxonomy" is adopted with slight changes. This is remarkably like Dr. T. A. Chapman's classification from pupal characters and the present writer's one on larval characters. All three agree in breaking up the old groups Zygænidæ and Bombyces, and the several members are referred to essentially the same places. The work affords for the first time a means for teacher as well as student to determine the family of any North American insect, for here synoptic tables replace the vague characterization so generally in vogue in zoology. To bring the tables down to species, as is done so satisfactorily in botany, as the author remarks, would make the work of enormous length, not to mention the fact that the present state of our knowledge of insects does not warrant such an undertaking. The work seems a very valuable and timely one.—Harrison G. Dyar.

We wish to add to the foregoing notice our hearty congratulations to Prof. Comstock and his talented wife upon the completion of their excellent work, and our tribute of praise for the thoroughly admirable manner in which they have performed it. It is now a little more than six years since we noticed in these pages the first part of this work, which consisted of 234 pages and 200 wood cuts; we then stated that "judging from the portion before us we have no hesitation in saying that the complete work will be a most valuable and admirable manual of entomology; in clearness and simplicity of style, in excellence of illustration and in arrangement of matter it leaves nothing to be desired." This prediction has been most completely fulfilled, the volume before us being, in several respects, even an improvement upon the original publication. The new illustrations are more artistic, and the diagrams of wing-venation and details are clear and accurate; the synoptic tables will afford any painstaking student satisfactory means of classifying into families any specimens that he collects, while the letter-press and figures will enable him to determine a large number of species. We heartily commend the work to all who are beginning to study entomology, and we can assure others, who have made some progress in the science, that they will find in it a vast deal of help and information that will prove of the utmost value. We may add that the illustrations consist of 800 wood cuts and six beautiful full-page plates, the one forming the frontispiece being coloured. The price of the work is so reasonable that it is within the reach of all.—C. J. S. B.

ɪNADIAN SPIDERS, by J. H. Emerton. Transactions of the Connecticut Academy, Vol. IX., July, 1894. Thirty pp., four plates.

This interesting and valuable paper treats of spiders collected in various parts of ınada from the Rocky Mountains to the Gulf of St. Lawrence. The author states at the tset that the species differ little from those of the New England States. "Out of sixty-one ecies, from Labrador to Manitoba, fifty-six species live in New England; and twenty-ven out of forty-eight species from the Rocky Mountains. Of the latter no less than rty of the species mentioned were collected by Mr. Bean at Laggan, and of these cteen are described as new to science. Mr. Tyrrell, of the Geological Survey of Canada, pplied other species from the Rocky Mountain Region, Alberta Territory and Ottawa, ıd other collectors from the various localities mentioned in the paper. The plates ustrating the new species are admirably drawn by the author, the excellence of whose ork in scientific illustration has long been well known and highly appreciated.—C. J. S. B.

REPORT OF OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS, DURING ɪE YEAR 1894, with Methods of Prevention and Remedy. Eighteenth Report. BY ɪEANOR A. ORMEROD, F. R. Met. Soc. etc., etc., London; Simpkin, Marshall, Hamilton, ent & Co, Limited, 1895, pp. 122, lxii, plate.

In this the author has given us another of her most excellent annual reports, if ıything, better than those that have preceded it. There are twenty-nine species, besides e two groups, Iulidæ and Vespidæ, fully treated in the report which is illustrated by rty five figures and one excellent plate, the latter devoted to the Stem Eelworm, *ylenchus devastatrix*, in connection with its recent discovery as injurious to hops. 'e congratulate the author on being able to give us so much information on Eelworms, 'arble Fly and carabid enemies of the strawberry. In fact she has, throughout her port strictly adhered to the plan expressed in the preface, viz., "not to enter again on such our common infestations as have been repeatedly noticed in my preceding reports, cepting where there was some new information to be given, or (sometimes) needed." ıis renders the report of unusual value. To do the publication justice is simply out of ıe question in an ordinary book notice, but suffice it to say that it is in every way a edit to its author.

The writer well remembers an evening spent with the late Frazer S. Crawford, at s suburban home near Adelaide, South Australia. We had been discussing entomology ıd entomologists, when he made a remark something like this. "Miss Ormerod is a ɔble woman and is giving both her life and her wealth to the agricultural interests of ngland, and I cannot understand why she should not be better appreciated by Englishen." The sentiment will be echoed by American entomologists, but I fear in our ırry and bustle, we forget to drop an occasional word of encouragement and appreciaon, such as we ourselves would gladly receive. Working almost alone, and comparavely unaided, in a labour of love not always appreciated, it seems to me that words of ıcouragement from her colleagues, both in America and out of it, are but matters of ıstice. Other reports on economic entomology there are, and they come officially from ıe Board of Agriculture of England, but the writer has searched through them in vain ır tokens of originality or just credit for the information contained in them.—F. M. W.

OBITUARY.

CHARLES VALENTINE RILEY.*

The career of this distinguished naturalist, so suddenly closed while in good health, ıd with apparently many years of usefulness before him, was a remarkable one. Biologist, tist, editor and public official, the story of his struggles and successes, tinged as it is ith romance, is one full of interest. Beginning life in America as a poor lad on an

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*The following memoir of our lamented friend, Professor Riley, contributed to a recent number of Science," by Professor A. S. Packard, is so excellent and complete that we prefer to give it in full rather an attempt to prepare another which would not be so satisfactory.—ED.

Illinois farm, he rose by his own exertions to distinction, and to become one of our most useful citizens in science, both pure and applied. His nature was a many-sided one, and his success in life was due to sheer will-power, unusual executive force, critical judgment, untiring industry, skill with pencil and pen, and a laudable ambition, united with an intense love of nature and of science for its own sake. This rare combination of varied qualities, of which he made the most, rendered him during the thirty years of his active life widely known as a public official, as a scientific investigator, while of economic entomologists he was *facile princeps.*

Charles Valentine Riley was born at Chelsea, London, September 18, 1843. His boyhood was spent at Walton-on-Thames, where he made the acquaintance of the late W. C. Hewitson, author of a work on butterflies, which undoubtedly developed his love for insects. At the age of eleven he went to school for three years at Dieppe, afterwards studying at Bonn-on-the Rhine. At both schools he carried off the first prizes for drawing, making finished sketches of butterflies, thus showing his early bent for natural history, and his teacher at Bonn urged him to study art at Paris. But it is said that family circumstances, though rather, perhaps, a restless disposition, led him to abandon the old country, and at the age of seventeen he had immigrated to Illinois, and settled on a farm about fifty miles from Chicago. When about twenty-one he removed to Chicago, where he became a reporter and editor of the entomological department of the *Prairie Farmer.*

Near the close of the war, in 1864, he enlisted as a private in the 134th Illinois regiment, serving for six months, when he returned to his editorial office.

He also enjoyed for several years the close friendship of B. D. Walsh, one of our most thorough and philosophic entomologists, with whom he edited the *American Entomologist.* His industry and versatility as well as his zeal as an entomologist, made him widely known and popular, and gave him such prestige that it resulted in his appointment in 1868 as State Entomologist of Missouri. From that time until 1877, when he left St. Louis to live in Washington, he issued a series of nine annual reports on injurious insects, which showed remarkable powers of observation both of structure and habits, great skill in drawing and especially ingenious and thoroughly practical devices and means of destroying the pests. The reports were models and will never become stale. Darwin wrote in 1871: "There is a vast number of facts and generalizations of value to me, and I am struck with admiration at your power of observation. The discussion on mimetic insects seems to me particularly good and original." In reviewing the ninth and last of these reports, published in 1876, the *Entomologists' Monthly Magazine* of London, remarked: "The author, in giving full scope to his keen powers of observation, minuteness of detail, and the skill with which he uses his pencil, and at the same time in showing a regard for that scientific accuracy—unfortunately too often neglected in works on economic natural history—maintains his right to be termed the foremost economic entomologist of the day." It goes without saying that this prestige existed to the end of his life, his practical applications of remedies and inventions of apparatus giving him a world wide reputation. In token of his suggestion of reviving the vines injured by the Phylloxera by the importation of the American stock, he received a gold medal from the French Government, and he afterwards received the cross of the Legion d'Honneur in connection with the exhibit of the U. S. Department of Agriculture at the Paris Exposition of 1880.

The widespread ravages of the Rocky Mountain locust from 1873 to 1877 had occasioned such immense losses in several States and Territories that national aid was invoked to avert the evil. The late Dr. F. V. Hayden, then in charge of the U. S. Geographical and Geological Survey of the Territories, with his characteristic energy and sagacity, initiated researches on the locust in the Territories. He sent Dr. P. R. Uhler to Colorado in the summer of 1875, and also attached the present writer to the Survey who spent over two months in entomological work in the same year in Colorado, Wyoming and Utah, publishing the results in Hayden's Ninth Report. Mr. Walsh had made important suggestions as to the birthplace and migrations of the insect. Meanwhile Riley had since 1874 made very detailed studies on the migration and breeding habits and means of destruction of this locust (published in his Missouri State Report for 1876 and 1877). Dr. Cyrus Thomas had also been attached to Hayden's Survey, and published a monograph on the locust family, *Acrididæ.* As the result of this combined work Congress created the United States Entomological Commission, attaching to it Dr. Hayden's Survey, and the Secretary of the Interior appointed Charles V. Riley, A. S. Packard and Cyrus Thomas members of the Commission. Dr. Riley was appointed chief, and it was mainly owing to his executive ability, business sagacity, experience in official life, together with his scientific knowledge and practical inventive turn of mind in devising remedies, or selecting those invented by others, that the work of the Commission was so popular and successful during the five years of its existence. Meanwhile in 1878 while the report of the Commission was being printed, Riley accepted the position of Entomologist to the U. S. Department of Agriculture, and during the season of 1879 and 1880 he investigated the cotton insects, but owing to the lack of harmony in the Department, he resigned, Prof. J. H. Comstock being appointed, and ably filling the position. Congress meanwhile transferred the cotton-worm investigation to the Entomological Commission. Riley was reappointed to the position of U. S. Entomologist in June, 1881. His successor, Mr. L. O. Howard, has stated how efficient, broad and thorough was his administration of this office : "The present efficient organization of the Division of Entomology was his own original conception, and he is responsible for its plan down to the smallest detail. It is unquestionably the foremost organization of its kind at present in existence." Again he writes : "Professor Riley's work in the organization of the Division of Entomology has unquestionably advanced the entire Department of which it is a part, for it is generally conceded that this division has led in most matters where efficiency, discipline and system were needed. Its plan and discipline have been cited by one of the heads of the Department as worthy of imitation by all, and your own honored Westwood, in expressing, in 1883, his admiration of Riley's work, said : 'I am sure it must have had a great share in inducing the activity in entomological work in America, which is putting to the blush the entomologists of Europe.' "

Indeed, so efficient, methodical and painstaking was Riley in whatever he undertook to do that had he been promoted to the position of Commissioner of Agriculture he would have been head and shoulders above any incumbent of that office, and, it is safe to say, would have administered its affairs with practical results far more valuable than those attained by any other Commissioner, as such an office should have been entrusted to a person who had had a scientific education, and not given as a reward for political service. As it is, he was the leader, says Mr. Howard, in many important innovations in the work of the department. His division published the first bulletin, and in *Insect Life* began the system of periodical bulletins, which has since been adopted for the other divisions of the Agricultural Department. He also took a large share in founding the Division of Economic Ornithology, Silk Culture and Vegetable pathology, the first two being placed for some time under his charge. In an address, says Howard, before the National Agricultural Congress, delivered in 1879, in which he outlined the ideal Department of Agriculture, Professor Riley foreshadowed many important reforms which have since become accomplished facts, and suggested the important legislation, since brought about, of the establishment of State Experiment Stations under the general government.

His practical, inventive genius was exhibited in his various means of exterminating locusts, in the use of kerosene oil emulsified with milk or soap, and in his invention and perfection—in which he was essentially aided by the late Dr. W. S. Barnard, who had special charge of the subject of mechanical appliances and remedies while connected with the Entomological Commission and the Agricultural Department, and whose "assistance was fertile from the first," as stated by Riley in his report—of the "cyclone" or "eddy-chamber" or Riley system of nozzles, which, in one form or another, are now in general use in the spraying of insecticide or fungicide liquids.

Although the idea of introducing foreign insect parasites or carnivorous enemies of our imported pests had been suggested by others, Riley, with the resources of his division at hand, accomplished more than any one else in making it a success. We will let Mr. Howard tell the story of his success, with the efficient aid of Mr. Albert Koebele, in introducing the Australian ladybird to fight the fluted scale:

> "One other trait which we have not mentioned is his *persistency in overcoming obstacles*. Nothing daunts him, and the more difficult an end is to attain, so much the more energy and perseverance does he put in its pursuit. A recent instance of this quality we may cite: The fluted scale (*Icerya purchasi* Maskell) has done immense injury to citrus fruit in southern California of late years. Ascertaining that it is kept in check by natural enemies in its native home, Australia, Dr. Riley foresaw the importance of endeavoring to introduce these enemies. Not only did Congress refuse to appropriate money for the purpose, but it refused to do away with a clause in the Appropriation Bill restricting all expenditures to the United States. In this state of affairs most men would have given up the fight; but Dr. Riley, after great trouble, succeeded in accomplishing his end by inducing the Secretary of State to allow the sending of two assistants on the Melbourne Exposition Commission, and through their labors the desired result was reached. Hundreds of specimens of an Australian lay-bird (*Vedalia cardinalis*) were introduced into California, and the dreaded pest is now being speedily reduced to absolute harmlessness. Professor W. A. Henry, of Wisconsin, in a recently-published article, says of this matter, in speaking of the enthusiasm of the people of California over the results of this importation: 'Without doubt it is the best stroke ever made by the Agricultural Department at Washington.'"

It might be thought that all this administrative work of the office and in the field would have left little time for pure science or for much general reading or deep thinking. Let us see what he actually did accomplish in pure science. Riley's scientific writings will always stand, and show as honest work, thorough-going methods, care and accuracy as his office work, and they alone, aside from his practical work, were enough to give him an international reputation. In some of his studies he was probably essentially indebted to his assistants for specimens and aid in rearing them; in others he evidently depended on his own unaided observations and his skill in drawing. He was not "a species man" or systematist as such; on the contrary his most important work was on the transformations and habits of insects, such as those of the lepidoptera, locusts and their parasites, his Missouri reports being packed with facts new to science. His studies on the chronology of all the broods known of the seventeen-year cicada, and its *tredecim* or thirteen-year race, carried on through a long succession of years, will prove of lasting value, having intimate bearings on evolution problems.

His work on the larval characters and hypermetamorphoses of the blister beetles, Epicauta, Macrobasis and Hornia, besides Henous, was thoroughly good and beautifully illustrated by his own pencil. He brings forward in this paper a mass of new facts regarding the triungulin, or first larval stage of these beetles, and those succeeding, which he designates as the Carabidoid, the Scarabæidoid stage, the Coarctate or quiescent larva, these stages preceding the pupa stage. The value of these facts as set forth by so trustworthy and keen an observer, and corroborating and greatly extending those worked out by European observers, is apparent when we consider that the triungulin larva is perhaps the nearest approach to the Campodea-like ancestor of the winged insects, that the Meloidæ are consequently among the most primitive and generalized of Coleoptera, and that from work based on such studies as these of the life-history of this and allied groups there has already resulted the germs of a truer phylogeny or classification of the entire order of Coleoptera. Of similar import are Riley's papers on the larval habits of bee-flies, on the luminous larviform females of the Phengodini and on the first larval stage of the pea-weevil (Bruchus). His studies on the systematic relations of Platypsyllus as determined by the larva evince his patience, accuracy and keenness in observation and his philosophic breadth.

For over twenty years he made observations on the fertilization of Yucca by those remarkable tineoid moths, Pronuba and Prodoxus, and from time to time published papers and notices of progress in his work which culminated in his paper entitled, "The Yucca Moth and Yucca Pollination" (1891-'92), a memoir remarkable for the patient, unremitting work carried on during his spare hours, its thoroughness in dealing with structural details, its critical accuracy, and for its faithful and artistic drawings. It is a paper of interest to botanists as well as zoologists, and of value to the student of evolution. One of his last papers was a continuation and résumé of this subject, entitled "Some Interrelations of Plants and Insects" (1892).

Riley's contributions to the history and structure of the Phylloxera, of the scale insects, of the hop-plant louse, the Pemphiginæ, Psyllidæ, etc., are of permanent interest and value. His best anatomical and morphological work is displayed in his study on the mode of pupation of butterflies, the research being a difficult one, and especially related to the origin of the cremaster, and of the vestigial structures, sexual and others, of the end of the pupa. Whatever he did in entomology was original. He may occasionally have received and adopted hints and suggestions from his assistants, but he laid out the plan of work, supervised every detail, followed up the subject from one year to another, and made the whole his own. His originality in a quite different direction from biology is seen in his paper entitled "Perfectionnement du Graphophone," read before the French Academy of Sciences at Paris, in 1889. He was also much interested in Aëronautics, and took much delight in attending séances of spiritualists and exposing their frauds, in one case, at least, where another biologist of world-wide fame, then visiting in Washington, was completely deluded.

Riley was from the first a pronounced evolutionist. His philosophic breadth and his thoughtful nature and grasp of the higher truths of biology is well brought out in his address on "The Causes of Variation in Organic Forms," as Vice-President, before the biological section of the American Association for the Advancement of Science in 1888. He was a moderate Darwinian, and leaned, like other American naturalists, rather to Neo-Lamarckism. He says: "I have always had a feeling, and it grows on me with increasing experience, that the weak features of Darwinism and, hence, of natural selection, are his insistence (1) on the necessity of slight modification; (2) on the length of time required for the accumulation of modifications, and (3) on the absolute utility of the modified structure." Riley, from his extended experience as a biologist, was led to ascribe much influence to the agency of external conditions, remarking, in his address: "Indeed, no one can well study organic life, especially in its lower manifestations, without being impressed with the great power of the environment." He thus contrasts Darwinism and Lamarckism: "Darwinism assumes essential ignorance of the causes of variation and is based on the inherent tendency thereto in the offspring. Lamarckism, on the contrary, recognizes in use and disuse, desire and the physical environment, immediate causes of variation affecting the individual and transmitted to the offspring, in which it may be intensified again both by inheritance and further individual modification."

The following extracts will illustrate his clear and vigorous style of thought and expression and his attitude on the relations between science and religious philosophy. Regarding the question of design, he says: "Both Lyell and Gray believe in the form of variation having been planned or designed. It seems to me that the evidences of design in nature are so overwhelming that its advocates have an immense advantage over those who would discard it. A fortuitous cosmos is, to most persons, utterly inconceivable, yet there is no other alternative than a designed cosmos. To accomplish anything by a process, or by an instrument, argues greater, not less power, than to do it directly, and even if we knew to-day all the causes of variation, and understood more thoroughly than we do the method of evolution, we should only carry the sequence of causes a step further back and get no nearer to the Infinite or Original Cause."

"Evolution teaches that nothing is yet so perfect but it may be improved; that good comes of the struggle with evil and the one can never be dissociated from the other. The erect position which has given man his pre-eminence has brought him manifold bodily ills. No evolutional sibyl looks to a millennium. Higher development must ever mean struggle. Evolution shows that man is governed by the same laws as other animals." "Evolution reveals a past which disarms doubt and leaves the future open with promise—unceasing purpose—progress from lower to higher. It promises higher and higher intellectual and ethical attainment, both for the individual and the race. It shows the power of God in what is universal, not in the specific, in the laws of nature, not in departure from them."

"The experience gained by those who have reached the highest ethical and intellectual growth must be formulated in precept and principle to be of any benefit to society at large, and the higher ethical sentiment and religious belief—faith, love, hope, charity—are priceless beyond all that exact science can give it."

Riley, an excellent head of a bureau, but sometimes uncomfortable and too independent as a subordinate, at times got into hot water with his superiors in the Department. He was sensitive to criticism, and was somewhat prone to controversy, usually, however, winning in such encounters. Until one came to know him more intimately he was liable to be misunderstood, and by his occasional bluntness made some enemies, but as years rolled on these passing antagonisms melted away.

Vigorous in mind and body, though of late years suffering from overwork, fond of out-door sports, he was a fearless rider on horseback, and an adept with the bicycle, on which, alas, he rode to his death.

His hospitable house at Sunbury was beautified by rare flowers, shrubs and trees, of which he was passionately fond. He was domestic in his tastes, and left a wife and five children to mourn his loss.

Riley left an indelible mark on his time, and the historians of natural science and of agriculture in America will scarcely ignore the results of thirty years of earnest work in pure and applied entomological science.

His scientific honors were well deserved. He was a member of many societies at home and of the entomological societies of France, Berlin, Switzerland and Belgium. He was elected in 1889 an Honorary Fellow of the Entomological Society of London, and was also Honorary Fellow of the Royal Agricultural Society of Great Britain. He was for two years President of the Academy of Science of St. Louis, being the youngest member so honored. He was founder, and for two terms President, of the Entomological Society of Washington, one of the founders of the Biological Society of that city, and an honorary member of the horticultural societies of Illinois, Iowa, Kansas and Missouri. The Kansas State Agricultural College gave him the degree of A.M., and the Missouri State University, in 1873, conferred upon him the degree of Ph. D. He was lecturer on entomology at Cornell University and at other institutions.

A. S. PACKARD.

Brown University.

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TWENTY-SEVENTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY

OF

ONTARIO

1896.

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE.)

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO.

TORONTO
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1897

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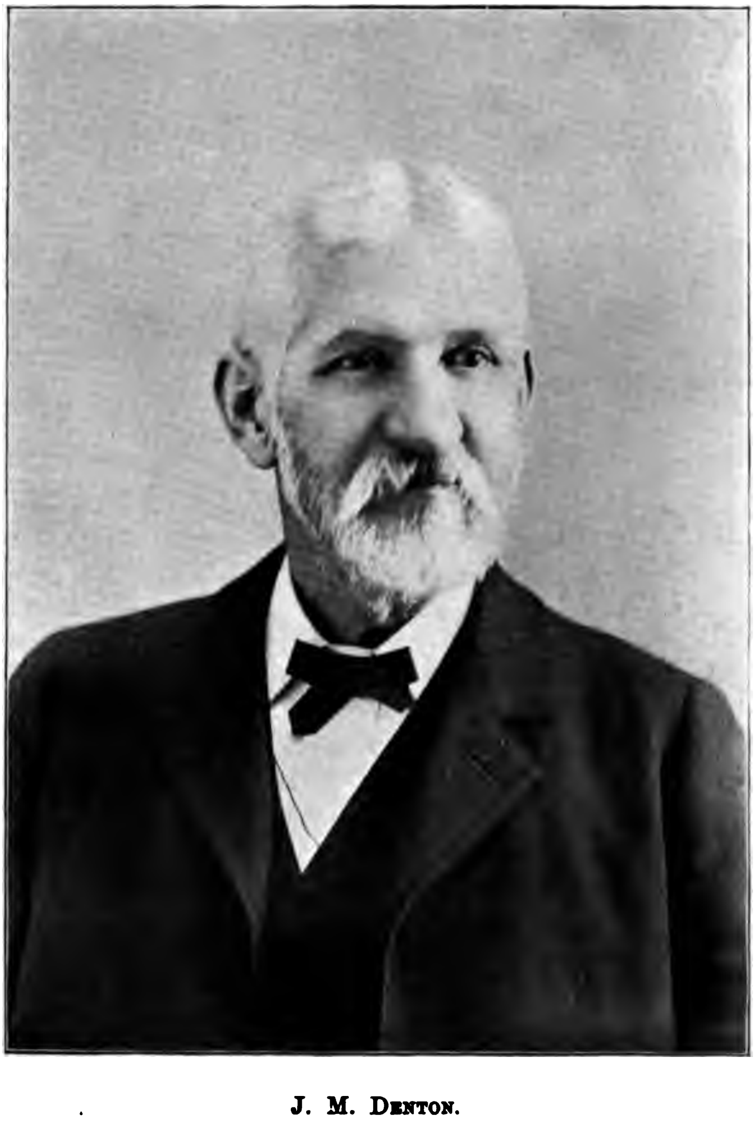
Rev. Thomas W. Fyles, F. L. S.

Member of the Council of the Entomological Society of Ontario, from 1882 to 1888; delegate to the Royal Society of Canada, in 1890, 1894 and 1895; member of the Editing Committee of the "Canadian Entomologist," since 1889.



J. M. Denton.

TWENTY-SEVENTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO,

1896.

To the Honorable John Dryden, Minister of Agriculture:

SIR,—I have the honor to transmit to you the Twenty-Seventh Annual Report of the Entomological Society of Ontario. It contains a full account of the proceedings at our thirty-fourth annual meeting, which was held in the city of London, on the 21st and 22nd of October last, for the election of officers and the transaction of the general business of the Society. The report includes the addresses delivered and papers read at the meeting, together with the financial statement of the Treasurer and the reports of the various sections and departments of the Society. Considerable attention is given to the outbreak of the "Army Worm" in this Province, last summer, and the destructive work of the "Tussock Moth" to the shade trees in Toronto, and other papers are submitted dealing with matters of economic and scientific interest in connection with the study of Entomology.

The Canadian Entomologist, the monthly magazine issued by the Society, has now completed its twenty-eighth volume, which will be found to contain a large number of papers of a highly scientific character contributed by the most distinguished students of this branch of science in Canada and elsewhere.

I have the honor to be, Sir,
Your obedient servant,
CHARLES J. S. BETHUNE,
Editor.

OFFICERS FOR 1897.

President	J. W. Dearness	London.
Vice-President	H. H. Lyman	Montreal.
Secretary	W. E. Saunders	London.
Treasurer	J. A. Balkwill	do
Directors :		
Division No. 1	James Fletcher, LL.D.	Ottawa.
" 2	Rev. C. J. S. Bethune, D.C.L	Port Hope.
" 3	Arthur Gibson	Toronto.
" 4	A. H. Kilman	Ridgeway.
" 5	C. G. Anderson	London.
Ontario Agricultural College	Prof. J. H. Panton	Guelph.
Librarian and Curator	J. A. Moffat	London.
Auditors	J. H. Bowman	do
	R. W. Rennie	do
Editor of the "Canadian Entomologist"	Rev. C. J. S. Bethune, F.R.S.C	Port Hope.
Editing Committee	Dr. J. Fletcher, F.R.S.C	Ottawa.
	H. H. Lyman	Montreal.
	Rev. T. W. Fyles	S. Quebec.
	James White	Snelgrove.
	W. H. Harrington, F.R.S.C	Ottawa.
Delegate to the Royal Society	J. D. Evans	Trenton.
Committee on Field Days	Drs. Woolverton and Hotson, Messrs. Balkwill, Saunders, Anderson, Rennie, Bowman, Elliott and Spencer	London.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

1896.

The thirty-fourth annual meeting of the Entomological Society of Ontario was held in its rooms, in Victoria Hall, London, on Wednesday and Thursday, October 21st and 22nd, 1896, the President, Mr. J. W. Dearness, of London, occupying the chair.

The meeting was called to order at 3 o'clock p.m , on Wednesday, when the following members were present: Rev. T. W. Fyles, South Quebec; Mr. H. H. Lyman, Montreal; Mr. J. D. Evans, Trenton; Rev. C. J. S. Bethune, Port Hope; Prof. J. H. Panton, Ontario Agricultural College, Guelph: Messrs W. E. Saunders (Secretary), J. A. Balkwill (Treasurer), J. Alston Moffat (Curator), J. H. Bowman, H. P. Bock, B. Green, W. Scarrow, T. Green, W. J. Stevenson, J. S. Pearce, J. B. Spencer, J. Law, W. Lochhead, W. Percival, and Drs. Woolverton and Hotson, London, and Robert Elliott, Plover Mills. Letters of apology were read from Dr. James Fletcher and W. H. Harrington, Ottawa, regretting their inability to attend the meeting.

At the request of the President the report of the Council for the past year was read by Dr. Bethune.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario beg to present the following report of their proceedings during the past year:

They have much pleasure in stating that the membership of the Society has been well maintained, and that there has been a gratifying increase in the members from Ontario and an especially large addition in the Montreal branch, from the Province of Quebec.

The twenty-sixth annual report on Economic and General Entomology was presented to the Minister of Agriculture for Ontario, in December last and was printed and distributed at the opening of the session of the Legislature. It contained one hundred and two pages, and was illustrated with thirty-four wood cuts and two full page portraits, one of the late Professor C. V. Riley, the most able and distinguished Entomologist in North America, who had been killed by a fall from his bicycle a few months previously, and the other of Mr. William H. Edwards, author of the "Butterflies of North America," the most valuable and important work of the kind ever published,—both of these gentlemen were honorary members of our Society. In addition to an account of the proceedings at the annual meeting, which included an interesting address on "The New Agriculture," by Mr. C. C. James, Deputy Minister of Agriculture, the volume contains the following valuable papers: "The value of Entomology," by Dr. James Fletcher; "How the Forest in Bedford was swept away," by Rev. T. W. Fyles; "Insect injuries of the year 1895," by Dr. Fletcher; "The growth of the wings of a Luna Moth," "Observations on the Season of 1895," and "Variation, with special reference to Insects," by J. A. Moffat; "Some winter insects from Swamp Moss," by W. H. Harrington; "Birds as protectors of Orchards," by Mr. E. H. Forbush; "The Rocky Mountain Locust and its allies in Canada," by Mr. S. H. Scudder. An abstract was also given of the proceedings of the seventh annual meeting of the Association of Economic Entomologists, together with some of the papers that were of special interest and value to the general reader.

The Canadian Entomologist, the monthly magazine published by the Society, completed its twenty-seventh volume in December last. The numbers of the twenty-eighth volume have been regularly issued at the beginning of each month during the current year; ten numbers, containing 270 pages, have thus far been published, containing a large number of papers of high scientific merit. The series of illustrated articles on the Coleoptera of Canada, by Mr. H. F. Wickham, has been continued and proves of great value to those studying this order of insects.

A fairly complete collection of the important insects of the country is now in the Society's cases. Some new and interesting species have been added during the year.

The most important addition to the library during the year is a complete set of the Annals of the Entomological Society of France. Nineteen other new volumes have been added and catalogued, besides the usual large number of scientific periodicals and exchanges.

The Council desires to express its satisfaction with the careful manner in which the Curator, Mr. J. Alston Moffat, continues to look after the collection of specimens, scientific instruments and library of the Society. Visitors have found him in constant attendance even outside of the hours at which he is expected to be present. Any one, whether allied with the Society or not, seriously studying any phase of insect life, has been cheerfully assisted by him. Farmers, horticulturists, and students bringing their specimens to the rooms in open hours, have thus the opportunity to have such compared with authentic specimens and identified.

The present accommodation which has served the Society since 1881 has become inadequate. Arrangements are being made to obtain new and more commodious quarters in the fine new structure in course of erection by the Young Men's Christian Association of this city.

The reports of the Secretaries of the several scientific Sections printed elsewhere show that, with the exception of the Ornithological one, they have held regular meetings at which useful and interesting lists of subjects were discussed.

The report of the Treasurer is highly satisfactory. The balance on hand, about $530, at the close of the financial year, August 31st, 1896, is larger than usual owing to the fact that some accounts had not then been presented for payment, but the current expenses for the remainder of the year will fully absorb this amount.

The Council desire to place upon record their grateful appreciation of the liberal grant from the Legislature of Ontario, which has enabled the Society to carry on during many years past its scientific and practical work in a manner which would otherwise have been impossible.

The Society was represented by Mr. J. D. Evans, of Trenton, at the annual meeting of the Royal Society of Canada, held in Ottawa, in May last. His report is also presented herewith.

It is with profound regret that the Council record the loss during the past year of two of their colleagues. Mr. John M. Denton, of London, one of the earliest members of the Society, died after an illness of some months on the 24th of March last. He was one of those who originally formed the London branch of the Society, and took a most active interest in it and the parent Society till the close of his life. For five and twenty years he was a member of our Council and did much to maintain the prosperity and usefulness of the Society. His sterling honesty, unfailing courtesy and genial hospitality won for him the respect and affection of all our members. We all deplore his loss as one personal to ourselves, and deeply sympathise wtih his widow in her bereavement.

On the 3rd of April Captain J. Gamble Geddes, of Toronto, died after a few days' illness, brought on by a severe cold. During several years he took an active part in the London branch and held the offices of Secretary-Treasurer, Vice-President and President in succession. After his removal from London he continued to take a great interest in the Society, contributing valuable papers to its publications and holding the position of

Director on the Council for many years. He was a diligent and enthusiastic collector in the order Lepidoptera and gathered together large stores of specimens, most of which are now in the museum of the Geological Survey at Ottawa. His untimely death is a source of deep grief to his colleagues and to a large circle of relatives and friends throughout the Dominion.

The Council desire further to tender their respectful sympathy to Miss Eleanor A. Ormerod, of Torrington House, St. Alban's, England, in her bereavement owing to the death of her sister and life-long colleague and companion, Miss Georgiana Elizabeth Ormerod, who died on the 19th of August last, after an illness of several months duration. The deceased lady was remarkable for her many talents and acquirements as a botanist, a conchologist, an artist, and a linguist, and for her great benevolence and generosity. She assisted her sister very greatly by illustrating her publications, helping in her correspondence and by her unfailing encouragement and wise counsels. She is widely known especially by the series of large coloured diagrams of injurious insects that she published under the auspices of the Royal Agricultural Society of England, and which are found to be of great practical use in illustrating lectures and addresses in this country as well as in Great Britain.

All of which is respectfully submitted.

J. W. DEARNESS,
President.

Mr. W. E. Saunders presented and read the report of the Secretary.

REPORT OF THE SECRETARY OF THE ENTOMOLOGICAL SOCIETY

FOR THE YEAR 1895-6.

The year 1895-6 has been one of unusual activity to the local members of the council into whose hands the conduct of affairs at the Society's headquarters is placed, but the labors of the Secretary have been reduced to a minimum by the kind and efficient work done by the Librarian and Curator, who has attended to almost all of the work which might otherwise have fallen upon the Secretary. During the early part of the year the council issued a leaflet setting forth the advantage and usefulness of membership in the Society; the said leaflet being for the purpose of enclosure in the correspondence of the members and it is hoped that the influence of the Society will be widened thereby.

Seven council meetings have been called during the year, and three consultation meetings, to which all the local members were invited; for the conduct of business in general, and more especially for that relating to the change of rooms.

The negotiations which had begun at the time of the last annual meeting with the Young Men's Christian Association of this city, for the lease of a room in their new building, have continued throughout the year and have about reached a favorable conclusion, so that unless a hitch occurs, the Society should be occupying the proposed new room in three or four weeks.

The routine work of the Society has proceeded as usual, the meetings of the sections having been regular, except the Ornithological section which did not meet during the year. Particulars of the work of the other sections will be given in the reports by their Secretaries.

Some correspondence has taken place with those in charge of the meeting in Canada of the British Association in which the Secretary has been authorized to pledge the goodwill and hospitality of the Society to the visiting members, but the matter of representation at the meeting has been left for the general council to settle at the annual meeting.

All of which is respectfully submitted,

W. E. SAUNDERS,
Secretary.

The Treasurer, Mr. J. A. Balkwill, read the following report of receipts and expenditure for the year ending August 31st, 1896 :

REPORT OF THE TREASURER

RECEIPTS, 1895-6.

Balance on hand Sept. 1st, 1895	$	341 91
Members' fees		324 54
Sales of Entomologist		82 59
" pins, cork, etc		127 18
Government grant		1,000 00
Advertisements		18 72
Interest		13 40
	$	1,908 34

EXPENDITURE, 1895-6.

Printing	$	571 43
Report and meeting expenses		159 42
Library		37 00
Expense account, postage, etc		78 90
Rent and fuel		103 05
Insurance		28 00
Salaries		300 00
Pins, cork, etc		99 01
Balance on hand, August 31st, 1896		530 93
	$	1,908 34

We the Auditors of the Entomological Society of Ontario hereby certify that we have examined the books and vouchers of the Treasurer, and find them well kept and correct, and that the above is a true statement of the accounts of the Society.

JAS. H. BOWMAN, }
W. T. MCCLEMENT, } Auditors.

Mr. Balkwill explained the several items of expenditure and stated that the balance on hand would all be absorbed in printing and other expenses before next year's subscriptions came in. The President in accepting the report, commented on the loss the Society had sustained through the removal of Mr. McClement, who has been appointed Lecturer in Chemistry in the Armour Institute at Chicago.

Mr. J. A. Moffat presented and read his report as follows :

REPORT OF THE LIBRARIAN AND CURATOR

FOR THE YEAR ENDING 31ST OF AUGUST, 1896.

The number of volumes added to the Library during the year was nineteen of which nine were exchanges bound for the Society; the others being received from various sources, already bound.

The most important of these were

The Missouri Botanical Garden.

The Year Book of the U. S. Department of Agriculture.

The Report of the N. Y. State Entomologist : Dr. Lintner.

The Report of the Gypsy Moth Commission.

The Proceedings of the Royal Society of Canada.

The Fifteenth Annual Report of the U. S. Geological Survey.

Acknowledgement is due to John Hamilton, M.D., Allegheny, Pa., for two volumes of his Coleoptera papers.

The whole number of volumes on the Library register is now 1,418.

A full set of the annals of the "Entomological Society of France," was obtained, in exchange for a full set of the publications of the Entomological Society of Ontario.

The number of volumes issued to local members was seventy-three.

But slight addition was made to the Society's native collection during the year; most of the new material obtained being yet undetermined.

Respectfully submitted,

J. ALSTON MOFFAT,
Librarian and Curator.

Dr. Bethune moved, seconded by the Rev. T. W. Fyles, that the Annals of the Entomological Society of France, and such other volumes as may be decided upon by a committee to be appointed by the President, be bound.—*Carried.*

By instruction of the local members of the council, the Secretary brought up the question of cataloguing the books in the Society's Library by the London Free Library Board as an addendum to their reference list. After some consideration of the subject, it was moved by Mr. W. E. Saunders, seconded by Mr. J. D. Evans, that this Society views with favor the proposition of the Free Library Board to publish a list of the books belonging to the Society in their catalogue.—*Carried*

The Secretary called the attention of the meeting to the importance of having the Society represented at the meeting of the British Association, which is to be held in Toronto next year, It was thereupon moved by the Rev. T. W. Fyles, seconded by Mr. Evans, that the President and Editor be, and are hereby, appointed to represent the Entomological Society of Ontario at the meeting of the British Association for the Advancement of Science, to be held in Toronto in 1897, and that the President be authorized to appoint additional representatives at his discretion.—*Carried.*

Mr. J. D. Evans then read his report as delegate to the Royal Society at its meeting in Ottawa in May, 1896, as follows:

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

As the representative of the Entomological Society of Ontario, I have the honor to submit a brief report of its proceedings and work during the past year.

It gives me much pleasure to be able to report that the membership continues to increase and is now much larger than ever heretofore, and that interest in its work is still unabated.

Valuable additions have been made to the Library and Collection of Insects—the number of volumes thus added being thirty-eight, making the total 1,399 volumes.

The Canadian Entomologist, the official organ of the Society, although not numbering quite so many pages as in the year previous, is yet largely increased beyond former years.

During the year 1895 it completed its twenty-seventh volume of three hundred and fifty-eight pages. There were forty six contributors, of whom twenty-nine were from the United States, three from England, and one from Germany—and of the remaining thirteen (Canadian) it is pleasing to be able to state that five of them were from the newer provinces west of Lake Superior. These contributed in the aggregate 100 articles in which were described 109 new species and seven new genera.

Among the more important papers published during the year may be mentioned the following:

The Coleoptera of Canada—Mr. H. F. Wickham, which ran through eight numbers.

Canadian Coccidæ—Mr. T. D. A. Cockerell.

Preliminary Studies in Siphonaptera—Mr. Carl F. Baker, which appeared in seven numbers.

Variation in Nemeophila Petrosa at Laggan in Western Alberta—Mr. Thos. E. Bean.

Synopsis of the Dipterous Genus Phora—Mr. D. W. Coquillett.

Mounting Insects without pressure—Mr. R. W. Rennie.

The Coleoptera collected at Massett, Queen Charlotte Island, B.C.—Rev. J. H. Keen.

Descriptions of the Larvæ of certain Tenthredinidæ—Mr. Harrison G. Dyar.

Notes upon the North American Saturnina, with List of the Species—A. Radcliffe Grote, A.M.

Butterflies of Southern Manitoba—Mr. E. F. Heath.

The Larvæ of the North American Saw-flies—Mr. Harrison G. Dyar.

The Life-history of Pamphilia Manitoba, Scud—Rev. Thos. W. Fyles.

To the aforementioned articles should be added also the numerous book notices of current publications of entomological literature, correspondence, obituary notices, etc,

In addition to the Monthly Magazine the Society publishes an Annual Report to the Department of Agriculture of the Province of Ontario, the twenty-sixth of which was issued in 1895, which consisted of 102 pages with numerous illustrations ; in this is given a very full report of the thirty-third annual meeting of the Society, which was held in their rooms in London, on Wednesday and Thursday, the 27th and 28th of November, 1895. An important feature of the annual meeting was an open meeting on the evening of Wednesday, in the City Hall, at which His Worship the Mayor presided and Prof. C. C. James, Deputy Minister of Agriculture of Ontario, delivered a very exhaustive and interesting address on "The New Agriculture," which was followed by Mr. James Fletcher with a very instructive address on "The Value of Entomology."

The annual report also contains the following papers :

How the forest in the District of Bedford was swept away—Rev. Thos. W. Fyles.

Insect Injuries of the year 1895—Mr. James Fletcher.

The growth of the wings of the Luna Moth—Mr. J. A. Moffat.

Observations on the season of 1895—by the same author.

Variation with special reference to Insects—also by the same author.

Some winter insects from swamp moss—Mr. W. Hague Harrington.

Birds as protectors of orchards—Prof. E. H. Forbush, Ornithologist of the Massachusetts Board of Agriculture.

The Rocky Mountain Locust and its allies in Canada—Mr. Samuel H. Scudder.

The reports of the Botanical, Geological and Microscopical Sections of the Society.

The report of the Montreal Branch.

The report from the Entomological Society of Ontario to the Royal Society of Canada.

And also a very full report of the proceedings of the seventh annual meeting of the Association of Economic Entomologists.

The Botanical Section reported that regular weekly meetings had been held during several months, at which the attendance was much in advance of previous years. Several papers had been read at the different meetings. One public field day was held at which much enthusiasm was manifested.

The Geological Section reported as having had a most prosperous year. The membership had increased, and average attendance at meetings was greater. A number of valuable papers have been contributed, and several very successful trips made to places of geological interest.

The Microscopical Section reported as having a number of very successful meetings at which a number of interesting subjects were presented.

The Montreal Branch presented their twenty-second annual report shewing a number of meetings held at which excellent papers were read, and the membership increased.

J. D. Evans,
Delegate.

REPORT OF THE MONTREAL BRANCH.

Mr. H. H. Lyman read the following report:

The twenty-third annual meeting of the Montreal Branch was held in the library of the Natural History Society, on Tuesday evening, 19th May, at 8.15 o'clock.

Members present: Messrs. H. H. Lyman, President; A. F. Winn, Vice-President; G. Kearley, G. C. Dunlop, Dr. Wyatt Johnston, E. A. Norris, J. B. Williams, E. T. Chambers, T. D. Brainerd, H. Brainerd, G. H. Moore, and Lachlan Gibb, Secy.-Treas.

The President presented the following report of the Council:

REPORT OF COUNCIL.

In presenting their twenty-third annual report the Council have much pleasure in referring to the increased prosperity of the Branch, especially in regard to the large number of new members who have joined during the year.

Since our last annual meeting eleven new members have been added to our roll, but we have to deplore the loss by death of Mr. E. M. Gibb, who had only joined the Society during the previous year.

During the year eight meetings have been held, and the following papers and communications were read:—

The Life history of Pamphila Manitoba—Rev. T. W. Fyles.

Note on the occurrence of Ællopos Titan—A. F. Wynn.

Notes on the season of 1895—H. H. Lyman.

Notes on the life history of Colias Interior—H. H. Lyman.

Description of the egg and young larva of Cerura Borealis—H. H. Lyman.

Notes on Trychosis Tunicula-rubra—Rev. T. W. Fyles.

Notes on the preparatory states of Erebia Epipsodea—H. H. Lyman.

The Importance of Entomological Studies to our Agricultural and Fruit Growing communities—Rev. T. W. Fyles.

Prairie and Mountain Plants—James Fletcher.

The larger Species of Argynnis and the Mystery of their Life History—H. H. Lyman.

During the season a course of short lectures to young people was inaugurated by the Natural History Society with the active assistance of our Branch. The lectures were delivered in the Society's lecture hall on Saturday afternoons, and it is hoped that they will have some beneficial effect in interesting some of the young people in natural history studies.

The Branch is under great obligations to the Natural History Society for the recognition extended to it as an affiliated society or section, such recognition carrying with it the valuable privilege of the free use of their rooms for our meetings when desired, while we retain unimpaired our connection with the parent Society in London.

The Council would recommend that all books belonging to the Branch should be inscribed with our name and placed in the Natural History Society's library on the understanding that we remain the owners of them, and that our members have free access to them.

The Treasurer's report shews that the finances of the Branch are in a healthy condition, and the Council would recommend to the new Council the advisability of considering how the surplus may be expended for the interest of the Branch.

Respectfully submitted on behalf of the Council.

H. H. LYMAN,
President.

The Treasurer submitted his report, and it was moved by G. C. Dunlop, seconded by G Kearley, That the reports of the Council and the Secretary-Treasurer be received and adopted. Carried.

The following officers were elected for the ensuing year:

President—H. H. Lyman.

Vice-President—A. F. Winn.

Secretary-Treasurer—Lachlan Gibb.

Council—G. C. Dunlop, G. Kearley.

The President then delivered his annual address in which he dwelt upon the necessity of more of the members taking an active part in preparing papers and sustaining the interest of the meetings. He also drew attention to some of the problems in connection with the Lepidoptera which awaited solution, some of which the members ought to be able to get some light on during the season.

Mr. G. Kearley, in moving a vote of thanks, suggested that the list of problems should be printed and a copy sent to each member.

The meeting then adjourned.

LACHLAN GIBB,
Secretary.

ANNUAL ADDRESS OF THE PRESIDENT OF THE MONTREAL BRANCH.

GENTLEMEN,—In most societies it is usual for the President to deliver an annual address at the annual meeting and this custom can, I think, be adopted in our Branch without disadvantage.

From the reports of the Council and of the Secretary-Treasurer it can be seen that the Branch has had a reasonably successful season, in regard both to the number of papers read and to the large number of new members who have joined us.

There is one point, however, to which I would earnestly invite your attention and that is that the labour of providing papers for the meetings is left too much to the President and I feel that I do not receive the assistance in keeping up the interest of the meetings that any President has the right to expect from the members.

With the single exception of Mr. Winn's "Note on *Aellopos Titan*" read at the October meeting, all the papers were contributed by me or secured by me from outside friends like Mr. Fyles and Mr. Fletcher.

It seems to me that every member might do something to contribute to the interest of the meetings.

The simplest paper upon anyone's experience would at least do something to relieve the annual report of the monotonous repetition of my name as the contributor of papers.

Subjects of discussion might be suggested and genera or groups taken up and systematically studied, the members bringing together all their material in these genera and verifying determinations, studying up the generic characters and so learning why a particular species is placed in a particular genus.

I doubt if any of our members can tell in what a *Neonympha* differs from a *Satyrus* or an *Erebia*, or a *Phyciodes* from a *Melitæa*. Then more interest might be shown in bringing specimens to the meetings. Specimens do not need to be rare in order to be worth showing. Well-set specimens in fine condition of even the commonest species are always a pleasure to look at, and it would at least show that the members were actually collecting specimens.

Further, I hold that every true entomologist should be something more than a mere collector of specimens. We should all seek to do some original work, no matter how little, in the field that we study.

A great temple of knowledge of scientific truth is being built up by the workers in all departments of science, in all lands, and through all the centuries and we should all strive to bring at least one stone, well cut and true, to build into this great temple.

There are many interesting questions awaiting solution and some of us ought to be able to do something towards elucidating some of them. To mention a few among the butterflies, *Danais Archippus:* How early does this species appear here? Is it ever seen before the end of June? Is there a second brood? Scudder thinks not in the north.

Argynnis Cybele. For this species my paper read at the last meeting is a sufficient indication of points that require elucidating and I should be very grateful for any assistance, particularly for the donation of living females as early as obtainable.

Argynnis Myrina. Why is the emergence of this species spread over so long a time as described by Scudder? Are there three broods here?

Melitæa Phaeton. This species is attacked by a Pteromalid parasite which has not been determined and its life history is unknown, though there is some reason to believe that it passes two years before completing its cycle, is this the case? I greatly doubt it.

Of *Grapta Comma,* Scudder writes that "careful statements of its comparative abundance are needed from all parts of Canada, before its geographical distribution can be fully understood." It is attacked by an unknown Dipterous parasite which should be determined.

Grapta Progne. Does this species feed on elm as stated by Harris? How late in the spring do the hibernators fly? When does the summer brood appear, become abundant, and disappear?

Eugonia J-Album. So little is known of this species that notes of every kind are desirable. Is there more than one brood? Why are there more individuals late in August and September than earlier? How long does it continue on the wing?

Vanessa Antiopa. When does the first brood of the season appear here? When the second? Does it ever hibernate as a chrysalis?

Limenitis Disippus. How many broods are there in this locality?

Satyrus Nephele. Is it subject to attack by any parasite?

Neonympha Canthus. Has it any parasites?

Neonympha Eurytris. Is there a second brood or part of a brood here? If so how does it compare in numbers with the first? Are there any parasites?

Pieris Oleracea. How many broods are there? Why has it so generally disappeared before *Pieris Rapæ?*

This last question is one which might puzzle any scientific man even of the first rank. Still there must be some reason for it and any of us might stumble on it.

Is it possible that *Oleracea* was comparatively free from parasitic attacks before the advent of *Rapæ* which is preyed upon by many species and that some of the latter's enemies have turned their attention to the former?

Our meetings are now closing and field work should begin. Will not the members strive to have something of interest to tell or show when we again begin our meetings in the autumn.

The branches other than Lepidoptera and Coleoptera, are sadly neglected. Can we not do something to work up our local forms of the Neuroptera, Orthoptera, Hymenoptera, Diptera, and Hemiptera?

H. H. LYMAN.

The following paper was then read :

NOTES ON THE SEASON OF 1896.

By the Rev. Thomas W. Fyles, F. L. S., South Quebec.

For half of the year Quebec seems to be the very throne of the ice king. The winters are long, and, in them, the storms are frequent, and the frosts severe. This spring people were crossing the St. Lawrence on the ice till St. George's day (April 23rd). When the " bridge " broke up a school-girl and one or two other persons were taken from the floating masses in canoes. Frost and snow come upon us in the end of October. The season then for out door Entomological work is a brief one—little can be done before the first of May, and but little after the end of September.

The fancy of the English Entomologist in Canada, must often revert with regret to his experiences in the old country—to his early spring work at the sallows, and his late captures at ivy bloom—to his welcome of *Gonepteryx rhamni* in February, and his farewell to *Pœcilocampa populi* in December.

To those who make a practice of rearing insects there will, even in the winter months, be occurrences of interest. Thus, early in the year on examining some cocoons and chrysalids that I had in the house, I found that a fine specimen of *Trogus fulvipes*, Cresson, had made its exit from a pupa of *Papilio Turnus*, Linn.

From a jar of earth in which a batch of larvæ of *Deilephila chamœnerii*, Harr. that had fed on *Epilobium coloratum*, Muhl, had buried themselves, I obtained—not the moths I expected, but—a number of two-winged flies of the species *Masicera anonyma*, Riley. The maggots of this species had destroyed the larvæ of the moth.

Our long winters afford us many opportunities for going over our summer captures, for identifying them and placing them in their proper order. And here I would record the capture at Sherbrooke, on the 25th ot May, 1895, by the Rev. Abbe Begin, of that very rare and elegant butterfly *Thecla læta*, Edw. It was sent to me in February of this year for identification.

The following is a description of it :

Thecla Læta, *Edwards*, (Male).

Colour above :—Black with a purple blush. Near the hind margin of the secondaries are three ultramarine patches, with a black reniform spot near the outer edge of each.

Colour beneath :—Ash grey approaching to brown with a slight blush of purple on the primaries. Towards the hind margin of these there is an indistinct line, with a touch of light red near the upper part of it.

On the secondaries there is an irregular, but curved, row of light red spots, each with an *outer* edge of white. Near the outer angle there are three other such spots with the *inner* edge of white.

One of our earliest species is *Brephos infans*, Moesch. It is found in the birch woods around Montreal, while the snow is yet on the ground. I have not found the species in this neighbourhood though I have often searched for it.

It is a common saying at Quebec, " We have no spring." Summer seems to burst upon us all at once. This year on the 19th of April the swallows came ; on the 21st flocks of ground-birds appeared ; on the 26th the first hibernated butterfly shewed itself.

The first caterpillars to appear openly are the " Woolly Bears." Full grown specimens of *Phragmatobia rubricosa*, Harr. may be seen in April, shuffling over the snow. In colour they are soft seal brown, slightly darker towards the head. The head is black and shining, and the feet are reddish brown. The specimens I have taken have not seemed inclined to feed, but have soon spun themselves up. Their cocoons have been light, and have had the larval hairs entangled in the meshes.

There is usually a space under the snowbanks, in the spring, caused by the warmth of the earth, and in this space vegetation commences. The creatures therefore may have fed up before they appeared upon the surface.

Among the immature larvæ that shew themselves in the early spring are those of *Euprepia caja*, Linn. On their first appearance at that season they are black, and about three fourths of an inch in length. They crawl out upon the side-walks, and upon the floors of out-buildings.

Some years ago I brought a batch of this species from the egg to perfection. They hibernated—if I remember rightly—after the second moult.

In the spring of 1891 I collected some larvæ of like appearance and habits, thinking I would raise a few more specimens of the moth. These larvæ moulted on the 4th of May, and shewed a broad side-line of red hairs, so I knew that I had been mistaken in supposing them to belong to *E. caja*. They again moulted on May 20th. On emergence from the old skins the heads and legs of the larvæ were honey-yellow, but they soon changed to jet black. On the 17th of June after having drawn, in every instance, a few leaves together for a tent, they went into chrysalis without spinning a cocoon. The chrysalid was blue-black with a bloom like that of an Orleans plum. The larval skin remained attached to the extremity of the chrysalis case. On July 10th the perfect insect appeared. It was *Arctia virgo*, Linn.

Speaking of larvæ, I would tell of the strange winter-quarters of a caterpillar of a noctuid which I found early in the year. The year before I had obtained a specimen of that very rare hymenopterous parasite, *Sphecophagus prædator*, Zabriskie. From its position when I found it, I judged that it must have come either from a nest of *Vespa media*, Oliv., or from a mud castle of *Pelopeus cementarius*, Drury, both of which I was keeping in a window of my study. Hoping to obtain more specimens of Prædator, I collected in the winter all the wasps' nests I could. Snugly coiled up in a cell of one of those brought to me was the larva I am telling of. It became active in the warmth of my room, but I had nothing among my house-plants that it would feed upon, and it soon perished.

May the 1st was a bright, cold day. Frogs were croaking amid the broken ice and masses of snow in the pools, and large banks of snow lay in the woods. The poplars, birches and alders were in catkin, and the leaf-buds of the red elder (*Sambucus pubens*, Michx.), *near the ground*, were opening. On this day I saw on the sunny side of a stem a specimen of *Vanessa Antiopa*, Linn., bright in colour, and without a flaw.

After the 1st of May vegetation progressed by leaps and bounds, and insect appearances multiplied. By the 13th such delicate forms as *Lycæna marginata*, Edw., *Nemoria gratata*, Walker, *Rheumaptera intermediata*, Gn., etc, were on the wing. On this date I saw a pair of *Osmia proxima*, Cresson, *in coitu* resting upon willow catkins. At the same time larvæ of *Pædisca saligneana*, Clemens, which had remained through the winter enclosed in webs within their galls on Solidago, left their domiciles and buried themselves in the soil. The imagos appeared on the 30th of May.

On the 15th of May a specimen of *Feniseca Tarquinius*, Fab., appeared in my breeding-cage. As the chrysalid had been out of doors all the winter this marks the date of appearance of the early brood of the species.

Lobophora angulineata, Grt., was common on the bolls of spruce trees on the 19th, and on the 21st *Lobophora atroliturata*, Walker, appeared.

On the 20th a full grown larva feeding upon choke cherry (*Padus Virginiana*, L.) was brought to me. The next day it buried itself and went into chrysalis. The following is a description of it: Length an inch and three quarters. Head, rather small, brown. Body plump and smooth. Colour, light drab. Spiracles outlined with dark brown. Just above them is a dark brown narrow side-line. On each segment a transverse dark brown line runs backward to a sub-dorsal line of lighter brown. On each segment along the back and pointing backward is a light brown V-like mark, with a pale patch on each side of it.

The larva could not have attained its growth in the fortnight in which the choke-cherry had been in foliage—it must have hibernated.

The buried caterpillar made a cyst strengthened by a slight web. The chrysalis was very dark glossy brown, and had a terminal spine. The moth appeared on the 27th of June, and proved to be *Mamestra imbrifera*, Guen.

The beautiful larvæ of *Phyciodes Harrisii*, Scudder, were common on the white aster (*Diplopappus umbellatus*, Tor. and Gr.), on the 21st of May and till the end of the month.

On the 6th of June I went to "The Gomin." In the fact that I knew no place there in which to sit down lay the chief discomfort of my first visits to this swamp. Fortunately in one of my rambles I discovered a huge solitary boulder half imbedded in the spongy soil. Now I am sure of a resting-place whenever I can find leisure to visit the swamp. I can sit or recline at ease on this stone, which surely some benevolent genie, anticipating the needs of weary naturalists, deposited far away from its original matrix.

Seated upon this stone that 6th of June I looked round upon the scene. Before me, some hundreds of yards distant, was the one tall pine, my landmark and guide to exit from the swamp. Around extended the level reaches of sphagnum, forming a vast amphitheatre bounded with tamarac and spruce. The surface of this area was beautified with innumerable blossoms. The prevailing colour was rose, from the lovely blossoms of *Rhodora Canadensis*, L., and *Kalmia angustifolia* L., but this was relieved by the white tufts of cotton-grass, *Eriophorum polystachyon*, L., and the clustered blossoms of the *Ledum latifolium*, Ait. The pitcher-plant, *Sarracenia purpurea*, L., lifted here and there its tall stalks, each surmounted by a yet unopened bud and resembling the maul-stick of the painter, and here and there the handsome blossoms of *Cypripedium acaule*, Ait., appeared.

In this solitude, seated upon my chair of state, I could almost fancy myself the monarch of all I surveyed, but thoughts of the kind were dispelled when I saw a *habitant* approaching. I noticed a peculiarity in this man's gait—he lifted his knees like a high-stepping horse, as he made his way through the yielding sphagnum. The motion struck me as grotesque; but soon afterwards, on moving away, I found myself making progress through the swamp in the same absurd fashion. I suppose it to be the mode of progression natural to the case.

As the man passed there now and then arose, disturbed by his approach, a specimen of that handsome chestnut-coloured moth *Epirranthus obfirmaria*, Hbn., or one of *Ematurga faxonia*, Minot, or one of *Chionobas Jutta*, Hübner.

Speaking of Jutta, I lately found among my papers a description of that butterfly written by a former member of this society, whose memory is dear to many of us—Mr. G. J. Bowles. I give it as a memento of our departed friend:

"*Chionobas Jutta*, Hübner. Lighter brown than Nephele, 3 eyelets in each fore-wing, centre one smallest, 4 or 5 on each hind wing, the one at anal angle largest. All the eyelets are small in size. Beneath, markings of fore-wings are repeated. Hind-wings marbled with brown and light grey, one eyelet near anal angle."

On June 10th, I took a pair of *Dolerus Aprilis*, Morton, among young spruce trees on Levis Heights.

On June 11th, a specimen of *Cerura cinerea*, Walker, burst from a cocoon that had been sent to me by a friend. This cocoon had been cut out from the boll of a poplar. It seemed to be formed of very fine woody particles cemented together into a case so hard that one might wonder how the insect could break from it. Examination showed that at the point of rupture the case was very thin. Besides *C. cinerea* I have taken, in Quebec province, *C. borealis*, Boisd., *C. scolopendrina*, Bdv., and *C. multiscripta*, Riley, the last named at Cowansville.

On the 15th June I saw several specimens of that handsome beetle *Rhopalopus sanguinicollis*, Horn, escaping from their tunnels in the stem of a red plum tree. They left oval openings large enough to allow of the insertion of a medium-sized goose-quill.

On the 24th of July I found full-grown larvæ of *Zarea Americana*, Cresson, feeding pon buck bean, *Menyanthes trifoliata*, L. I find this species every season in the same ot, and only in that spot. The larva has the habit of curling itself round with the ad on the outside. The following is a description of it:—Head black and shining, a hter shade just above the mandibles. Eyes protuberent, glossy black. The back of e larva is lead colour, inclining to blue. The second segment near the head and the al segment are paler. Along the back are eleven cross-bars, formed of a central black ot with an oblong patch of yellow on either side, terminated on either side with another ack spot. Between every pair of these bars are two cross lines of smaller black and *le* yellow dots. Along the edge of the lead colour on either side is a row of eleven nspicuous black dots. Below it is a broad yellowish-white spiracular line. The spiracles e small and black. Underneath them is a row of deep yellow warts each surmounted ith two black dots. On the underside the larva is yellowish-white. The true legs are pped with black.

I do not know the larvæ of *Abia Kennicotti*, Norton. There are two specimens of e fly in the Provencher collection. The differences between the imago of this species d that of *Z. Americana* are these: Kennicotti is smaller than Americana. Its colour black with a tinge of green, whilst that of Americana is brown with a tinge of scous. Kennicotti has a distinct mark like a reversed Y, extending from the costa to e inner margin of the fore-wing. In Americana this wing mark is confused. The stal line and the venation of the fore-wings in Americana are heavier and more dis-ct than those of Kennicotti. The abdomen in Americana is somewhat spatulate; in ennicotti it is rounded. The underside of the abdomen in Kennicotti is black; in mericana it is fuscous.

During the month of August pressing duties and frequent journeys hindered me m giving attention to entomological pursuits. This was unfortunate, for in one of my nes of absence I lost a brood of young larvæ of *Hepialus argenteomaculatus*, Harris, ich had come from eggs sent me by Mr. A. F. Winn. These eggs were round and ack, and under the microscope resembled grapes. In the hatching they were ruptured egularly. The young larvæ appeared in the last week of August. They were one-nth of an inch long. The head was disproportionately large—suggestive of a boring bit. It was brown, and there was a brown shield on the second segment. The body s yellowish white, warty, and set with long hairs. The fore-legs were brown.

In September may be found in the leaves of the Golden Rod (*Solidago Canadensis*,) eye-like spots, yellow in the centre with a surrounding of reddish brown. Osten cken made a guess at the insect producing these, and named it *Cecydomyia carbonifera*, m the black substance, not unlike charcoal that is found in the galls. For several ars I endeavored to raise the fly without success—I think for the reason that I did not llect the blistered leaves early enough. I am under the impression that the larvæ of e fly abandon the leaves, and undergo the pupal change in the herbage or the soil. e parasites of the species remain in the leaves. I raised two kinds of these in abund-ce, viz.: *Torymus Sackenii*, Ashmead and *Polygnotus solidaginis*, Ashmead. The first med, as seen under the microscope, is a marvel of grim beauty—a polished gem, glow- with crimson, green and gold. The latter is of more sober hue. It is admirably scribed by Mr. Ashmead in his monograph of the Proctotrypidæ, p. 307. The cocoons the species may be found in the blisters, three or four in a cluster.

This year I think I have succeeded in raising the original cause of the gall. It is *Sciara* closely allied to *S. ocellaris*, Coms. The following is a description of it: Expanse wings, two-tenths of an inch; length of body, one-tenth; length of antennæ, one-entieth. Hairy, of a uniform light brown; head rather small; eyes reniform; antennæ, jointed; mouth organs large; thorax large, rotund; abdomen long, attenuated; wings her dusky—a peculiar loop in the venation; halteres, club shaped.

While speaking of Hymenopterous parasites, I should like to express my admiration the work among the Hymenoptera that is done at Washington by Mr. Howard and *confreres*.

Mr. Howard's bulletin on the Joint-worm Flies, for its grasp of the subject, its clearness of description, and the beauty of its illustrations is a model work. Mr. Marlatt's NEMATINÆ is also first-class—excellent in every way. Of Mr. Ashmead's PROCTOTRYPIDÆ I can say, that the more I study it, the more I marvel at the amount of care and research that it betokens. It is a very mine of information.

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On the 10th of this month I went to the St. Henri woods. *Colias Philodice*, Gdt. and *Chrysophanus Americana*, D' Urban, were on the wing. Besides them a few locusts and crickets, two noctuids out of reach, a two-winged fly (*Sericomyia militaris*, Walker), and a beetle (*Necrophorus tomentosus*, Web.) were all the perfect insects I saw.

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I have taken many a walk and examined many a tamarack in the hope of finding cocoons of *Platysamia Columbia*, Smith, a species that was taken at Quebec by Mr. Bowles. Some years ago I found a vacated cocoon of the species. I greatly fear that *Nematus Erichsonii* by stripping its food trees has banished this fine species from the locality.

SOME INSECTIVOROUS MAMMALS.

BY ROBERT ELLIOTT, PLOVER MILLS.

Under the above heading I would like to treat in a popular way of a group of animals which, on account of their food habits, have a more or less direct bearing on the science of economic entomology.

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Unfortunately the term "insectivorous" as applied to a bird or a mammal seems to imply that the food of the species in question is in some way necessarily confined to what we call injurious insects. As a matter of fact little or no discrimination between beneficial and injurious insects has been ascertained as being made by any of our mammals in the choice of their food.

A skunk, foraging through the damp and shady wood, will, on finding one, munch a golden Calosoma with the same avidity that it crushes a May beetle. Most of our terrestrial insects, good and bad as we classify them, are no doubt held to be invariably good by the hungry shrew lucky enough to capture them. From the bat point of view, the *raison d' être* of night flying insects is quite likely enough considered simply as an essential requirement in order to keep the old and exclusive bat family in its proper position at the head of all living things. Nevertheless much good may be done without conscious discrimination; the farmer may derive a benefit from an act performed by a creature not dreaming of his existence. If it can be shown that the despised bat, the misunderstood shrew and the persecuted mole, from an economic point of view, "do good by stealth and blush to find it fame," it may be accepted as sufficient justification for the appearance of this paper in the pages of an entomological report.

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Their relationship to other groups has never been clearly elucidated. No scientific explanation of their origin is afforded by the investigation of their fossil remains. In short any fossil hitherto discovered has been either all bat or no bat at all. While they are thus easily separated from all other groups, when we come to the consideration of how many species we have, the greatest difficulties are at once encountered.

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3. *Adelonycteris fuscus* (Palisot de Beauvois), The Brown Bat. Five specimens. Perhaps the commonest species in the more settled parts of the country. Of wide range.

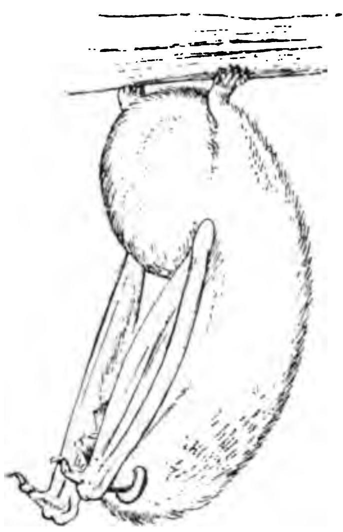

Fig. 1. Shows a Red Bat hanging by hind feet. Natural size.

4. *Atalapha noveboracensis* (Ecxleben), The Red Bat. Five specimens, three adult and two young. Our most brilliantly coloured species. Habitat, North America at large, excepting the coldest regions.

5. *Atalapha cinerea* (Palisot de Beauvois), The Hoary Bat. Two specimens. Our largest bat. Habitat, Northern regions, occuring southward only at high altitudes. The capture of two specimens at London must be considered highly interesting to the student of zoo-geography.

Of the twenty-eight species treated by Dr. Allen as North American, the five given above seem to be all that have as yet been found in Ontario.

Vesperugo carolinensis (Geoff), The Carolina Bat. Ranging from Massachusetts and Pennsylvania southward, will possibly be found in Ontario.

Upwards of 400 species are known in the world. In the tropics large fruit-eating forms are abundant. Those of temperate regions, as ours, are almost exclusively insectivorous and as such must, generally speaking, be considered beneficial.

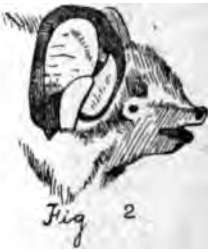

Fig. 2. Profile of head of same. Natural size.

Occasionally bats find shelter in badly constructed dwellings. There they congregate each morning in increasing numbers and finally, with much chattering and quarrelling they sink into their long hybernatory sleep.

In some cases the owner of the house, after different attempts to smoke them out with sulphur, is often driven to tearing off boards, and after considerable trouble and expense, gets rid of a colony of one hundred or more.

The most curious zoological fiction connected with bats is the absurd belief that they are the offspring of bed-bugs. Once a wise-acre of our country-side gravely advanced to me this untenable theory of the origin of bats. While admitting that owing to the similarity of their retreats bats might transfer the "bugs" to new quarters, I combatted as best I could the ridiculous statement by showing that it was a wholly unnecessary assumption. But lo! he, as if to demonstrate that "there are more things in heaven and earth than are dreamt of in our philosophy," challenged me to deny that *gorillas* had crossed over from Africa and had taken an effective part with Wellington in the Peninsular campaign against the French. In vain I defined the term "guerilla warfare"—he, forsooth, was a captain of our Canadian volunteers, and not wishing to have exemplified on myself his conception of a "gorilla attack," I escaped the dilemma with the diplomatic rejoinder that one story seemed as true as the other.

THE MOLES AND SHREWS.

While we have here to treat of (scientifically speaking) a very different order from the bats, from an economic point of view their similarity is well shown by a quotation from Carl Vogt: "One may, indeed, say with truth that they continue on and under the earth, yes, and even in the water the persistent hunt for insects, snails and all possible vermin, begun by the bats in the air."

The insectivora is a large order of mostly small mammals, forming one of the primitive types of their class. Two families—Talpidæ (moles) and Sorecidæ (shrews)—are well represented in the fauna of Ontario. While externally these animals simulate the appear-ice of mice, they are in internal structure widely different. The rodent type of teeth as ustrated by the common meadow-mouse, or *vole* (Arvicola riparius), whose sharp, chisel-aped incisors and flat-topped molars are admirably adapted to the gnawing and grinding the farmer's grain and roots, is replaced in the moles and shrews by a totally different ntition. Here we have projecting incisors, mostly one pair, canines, pre-molars with inted crowns and (usually) trifid molars—a machine well fitted for the capture of rrestrial insects, whose hard elytra are crushed with a facility truly surprising.

That the distinction between a *shrew* and a *mouse* is not more clearly known is a cided misfortune to both the farmer and the shrew. Meadow-mice feed on the farmer's ops and are generally treated as they truly are—that is, unmitigated pests. Shrews ed on insects and (in the case of one species, at least) on those very mice the farmer so rdially dislikes. Yet to the average farmer every little furry creature that runs rough his fields is merely a mouse, nay even worse than that, if any distinction is ade at all, it is usually against the poor little "screw mouse"—an unreasonable pre-idice allied to superstition. I have seen a farmer really afraid of a tiny shrew as it arted hither and thither with amazing rapidity in its frantic efforts to escape. To one f such I told, with a touch of irony, a curious superstition held by the Eskimo of Norton ound, as related by Mr. Nelson in his "Natural History of Alaska."

"Those Indians claim that there is a kind of water-shrew living on the ice at sea which exactly like the common land shrew in appearance, but which is endowed with demoniac uickness and power to work harm. If one of them is disturbed by a person it darts at he intruder, and burrowing under the skin, works about inside at random and finally nters the heart and kills him. As a consequence of this belief the hunters are in mortal terror if they chance to meet a shrew on the ice at sea, and in one case that I know of a hunter stood immovable on the ice for several hours until a shrew he happened to meet disappeared from sight, whereupon he hurried home, and his friends all agreed that he had had a very narrow escape."

The moles are completely fossorial in their habits, and possess in a high degree the traditional pugnacity of all miners. One meeting by chance a rival above ground, fights with a fierceness that carried on in proportion by large animals would be really terrific.

The earth worm forms the staple food of moles, and as this worm is accounted an important factor in the formation and improvement of soils, the mole must, to that extent, be considered an injury to the agriculturist.

The disfigurement of lawns and gardens by the large quantities of soil thrown up by even a single mole in a night is a serious charge, more applicable, however, to the English mole than to any of ours. The still more serious indictment that our common mole eats the roots of vegetable and other garden plants is likely enough a slander. A mole in a garden burrows along a row of plants in order to procure the numerous grubs and insects which congregate in just such places. Later a *vole* (meadow-mouse), entering the tunnel, finds ready access to its favorite article of diet—the roots of garden vegetables. There is the mole's tunnel—there are the potatoes eaten—and so the mole is condemned.

The Ontario species are three in number.

1. *Condylura cristata* (Linn).—STAR-NOSED MOLE.—A most unique species, owing its

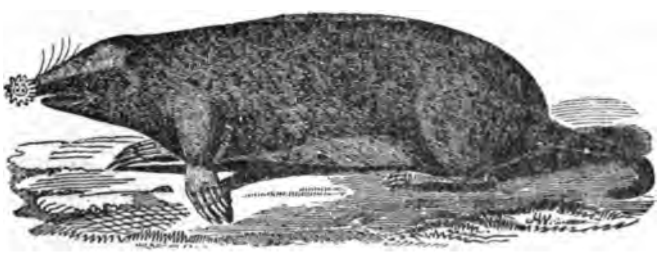

FIG. 3. The Star-nosed Mole (reduced.)

ame to about a score of radiating cartilaginous processes on the nose. Partial to moist ituations, and so far as my own observations go, our commonest species. Fig. 3 reduced).

2. *Scalops aquaticus* (Linn).—SHREW MOLE.—The term *aquaticus* as applied to this species is a misnomer, as in its habits it shows a preference for the drier ground, coming frequently into gardens and being of doubtful utility there. Apparently rare in Ontario.

3 *Scapanus Americanus* (Bartram).—HAIRY TAILED MOLE, BREWER'S MOLE.—More northern than either of preceding. In habits resembles the shrew mole. One taken at Ottawa, as reported by Ottawa Field Naturalists' Club, 1890.

The shrews are much more terrestrial than the moles, and are still more mouse-like in their appearance. However, their long, pointed and movable muzzle should serve to distinguish them from mice. Their position in the economy of nature is, as has been pointed out, vastly different. They feed on insects the year round, and are nocturnal in their habits. They are all small, some exceedingly small, the Etruscan shrew, found in Italy, being the smallest of known mammals. Its head and body measure only an inch and a half in length, and its tail adds about an inch more.

What shrews lack in size they atone for in numbers, activity and voracity, and from an economic point of view they must be reckoned among the farmer's best friends. Two genera and several species occur in Ontario.

1.—*Blarina brevicauda* (Say.) SHORT-TAILED SHREW. More mole-like in appearance than any member of the next genus. Besides destroying innumerable injurious insects in the course of a year, this industrious mammal is a persistent enemy to mice, following them into their burrows and killing them there. Common in Ontario.

2.—*Sorex Cooperi*, Bachman.—COOPER'S SHREW. This little dweller of our fields and woods is by no means so rare as its infrequent capture would lead one to suppose. While it moves in its agile, restless manner usually on the surface of the ground, it manages to travel under cover of dead leaves and herbage, thus eluding the notice of all but the keenest observer. Once in the woods about the middle of May, searching for salamanders, under rotten logs, etc., I captured alive a specimen of this diminutive shrew which I had disturbed and driven from his sylvan retreat. Placing it in a large bottle with a handful of cotton batting, I watched it dart through and through the cotton with astonishing rapidity. Half an hour later I introduced a live May beetle which was instantly attacked and entirely eaten. Within ten minutes I proffered an earth-worm which was immediately caught at the head and bitten down the middle throughout its whole length. The action although quickly performed left a groove or cut as neatly as any dissector could have done with a knife. The worm at once collapsed and from its whiteness I inferred that its blood had been extracted during the nipping process. As it remained untouched, within another ten minutes, wishing to know whether the shrew's appetite had been satisfied or whether it preferred insects to worms, I dropped in a second May beetle which was at once killed and the major portion eaten, the head and elytra alone remaining. Shortly afterwards the voracious little creature died, overcome as it seemed by the very abundance of supplies—a death suggesting, though somewhat dissimilar from, that of the farmer who, according to the Porter in "Macbeth," "hanged himself on the expectation of plenty."

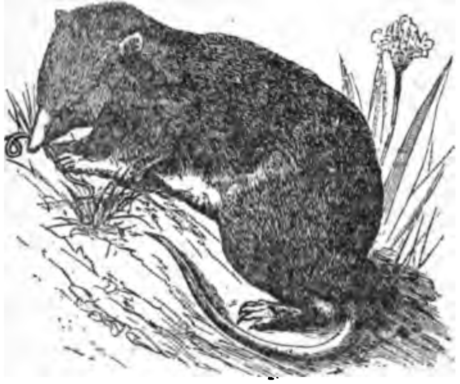

Fig. 4. SOREX ARANEUS.—A Typical Shrew.

3.—*Sorex platyrhinus* (De Kay) BROAD-NOSED SHREW. In August, 1895, I captured in a field of reaped oats near Plover Mills, an individual of this species which as far as I know remains the only record for Ontario. In habits it differs in no marked degree from its congener, Cooper's Shrew. Fig. 4.—The common European Shrew (*Sorex araneus*)—a typical representative of the large and useful genus, Sorex. Natural size.

THE RACCOON (*Procyon lotor.*)

While the Raccoon is perhaps the most omnivorous of all our mammals, eating with avidity birds and their eggs, frogs, fish, cray-fish, nuts, fruits, corn and sometimes poultry, yet before framing an indictment against him we should give him fair credit for large numbers of insects and mice destroyed in the course of a season.

I have examined the stomachs of many 'coons killed during the time the corn was in the milky stage, and have nearly always found more insects than anything else, notably the red-legged locust, in seasons when that pest was most destructive.

THE SKUNK (*Mephitis mephitica*).

In the face of the unsavoury reputation with which common report invests the Skunk—a reputation partly acquired from an *occasional* raid on the poultry yard to kill chickens or to suck eggs, and partly by reason of his defensive and offensive odour, it is pleasant to quote from Dr. Merriam, the highest authority on North American mammals, the following testimonial as to his sterling qualities: "Of all our native mammals perhaps no one is so universally abused, and has so many unpleasant things said about it, as the innocent subject of the present biography, and yet no other species is half so valuable to the farmer. Pre-eminently an insect-eater, he destroys more beetles, grass-hoppers and the like than all our other mammals put together, and in addition to these devours vast numbers of mice."

In discussing this interesting paper, Mr. Fyles asked whether it were correct that a noticeable difference between a mouse and a shrew was that a cat would not eat a shrew, because it was carnivorous and therefore not suitable for food.

Mr. Saunders said that this was probably not because the shrew is carnivorous, but because it had a peculiar and unpleasant odour, derived from a sack or gland, and that this caused cats, hawks and owls to prefer other mammals. He then exhibited a series of skins of bats, and gave a brief account of each species.

Dr. Bethune, in commenting on the usefulness of skunks, mentioned the benefit they confer upon hop-growers by destroying the larva of a moth, *Gortyna immanis*, which is often very injurious to the plants. This caterpillar eats into the crown of the root and if unmolested gradually burrows through and causes the death of the whole plant. In the hop-yards in the northern part of the State of New York it is related that the owners encourage the presence of skunks and do not allow them to be molested. These animals prowl about the yard and by listening at the foot of a hop-plant discover whether there is a worm gnawing at the root; if so they speedily dig away the earth and extract and devour the worm. It only remains then for the grower to replace the earth and thank his unsavoury friend for the benefit that he has conferred in saving the life of the plant. This injurious insect the speaker had found very abundant some years ago in a large hop-yard at Erindale, near Springfield-on-the-Credit.

Mr. Fyles then exhibited a fine collection of insects recently taken in Barbados, West India Islands, by his son. After the inspection of these and other specimens that were brought by the members present, the meeting adjourned.

EVENING SESSION.

In the evening the Society held a public meeting in its rooms in Victoria Hall, at which there was a largely increased attendance of members, between thirty and forty being present. The chair was taken by the President, Mr. Dearness, at 8 o'clock. After explaining the much regretted absence of Dr. Fletcher, who was unavoidably prevented from attending, he proceeded to deliver the annual address, which he illustrated with specimens and drawings on the blackboard, and also with photographs, and which was listened to with great interest and attention.

ANNUAL ADDRESS OF THE PRESIDENT.

BY J. DEARNESS, LONDON.

Friends and Members of the Entomological Society of Ontario :

I have the honor this evening to welcome you to the thirty-fourth annual meeting of the Society. By name, at least, I know of five other similar Societies on this continent: the American, the Cambridge, the Newark, the New York, and the Washington. The organization of only one of these, the first named, antedates that of our own Society.

The thirty-fourth annual meeting! To the younger members, who, but for a year or two have been witnesses of the work done in these rooms, and who have been reading the reports and the monthly issues of the *Canadian Entomologist*, it may be worth while to say that there is evidence that each and every one of these thirty-four years has been characterized by energy, progress and success, one almost equally with every other from the first until now.

The evidence is not far to seek, in fact we are overwhelmed with it. These shelves, stocked with reports and volumes, filling two sides of the room, tiers of drawers and cases of specimens, classified and catalogued, crowd us so that we scarcely have room for our chairs. Very material evidence this, even on the surface, that busy men founded this society and labored to promote its interests. In doing this great work two objects or purposes conspicuously inspired them—devotion to science for its own sake, and the desire to discover and disseminate knowledge for the sake of their fellow-men. No other incentive seems to have had any existence in their minds.

On the eve of removing from these rooms, where so much of the society's work has been done, to more commodious and convenient quarters, it seems opportune to turn our thoughts to the labors of the Society's veterans. We younger members cannot over-appreciate the rich heritage left us by these pioneers, and we should be stimulated by the contemplation of it to prepare ourselves to carry on the work in the spirit and enterprise of the example they have set us. The events of the year give emphasis to this statement. I presume only one person here can recollect attending an annual meeting before this one from which our beloved friend, the late Mr. Denton, was absent. His kindly voice, and that of another officer of this society, Capt. Gamble Geddes, of Toronto, have lately been hushed in death. The thought of their passing and leaving the work here which they had so much at heart suggests the desirability of the Society's compiling a memorial album, with portraits and sketch of its founders and its most earnest and useful workers.

A moment ago I said, "only one person here." I need not name him, as you all know it must mean the venerable editor of the *Entomologist*, Dr. Bethune, of Port Hope. Was he not at the inception of the society thirty-four years ago (in fact he and Dr. William Saunders, now director of the Dominion Experiment Stations, were its parents in every sense), and has he not attended nearly every annual meeting since its inception? May that one be many a year distant when he shall cease to be present; I can hardly conceive what one would be like without him and Dr. Fletcher and the Rev. Mr. Fyles. And although they all seem good for many years to come, yet you younger members must prepare to take their places sometime. I trust that even now you are observing, studying, reading—equipping to sustain and extend the good work so successfully begun.

Much has been accomplished, a very considerable library has been founded, much valuable material has been accumulated, a fairly complete taxonomy of the important insects of Canada and the neighboring States, has been placed on exhibition, and thus a foundation has been well laid that will enable future workers to specialize and to engage in practical studies with definite purpose.

SOME INJURIOUS INSECTS.

It has been usual for the President, in his annual address, to present an economic entomological survey of the province. My field of observation has been limited to the six or seven townships around London.

Last year our Curator, Mr. Moffatt, reported the prevalence of the cut-worm moth, *Hadena Arctica* (Fig. 5) Householders in town and country remember the nightly dance of these moths around the lamps and their soiling of curtains and clothes during the day. This spring I noticed many a patch of spring grain that had been sown on plowed sod so badly eaten that the ground was plowed again and sown with peas or otherwise used. The farmers said the wire-worms are at work, but in any plot I examined it was no trouble to discover the greenish-yellow cut worm, the larvæ of the *Hadena*. Would rolling the affected part of the field at night with a heavy roller across the drills destroy enough of these larvæ to save the crop? I should like to hear the point discussed whether we may expect another invasion of our homes by this moth next year, such as Mr. Moffat described in the last report. I did not find any specimens that seemed to be parasitized.

The grasshopper or locust (*Melanoplus femur-rubrum*, De Geer, Fig. 6) was not nearly so injurious as in 1895. Its partial disappearance is probably mainly due to the increase of its parasite, the red mite, *Astoma* (Fig. 7).* The spring was favorable for the development of the grasshopper, and in some localities it was present in prodigious numbers. I never saw them more numerous or vigorous than on the 18th of June along a side road between Con. vii. and viii. of McGillivray. Two or three miles on either side of this locality but few were to be seen. Where they were numerous I did not find one parasitized specimen; where they were scarce but few had not the red mites adhering to them under the wings.

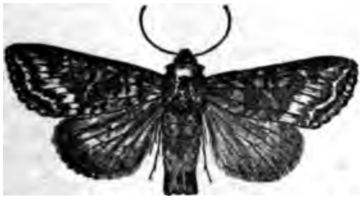

Fig. 5.

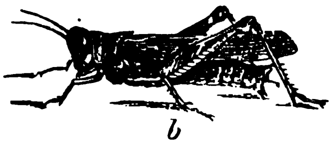

Fig. 6.

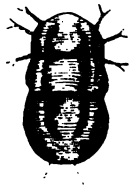

Fig. 7.

In a few limited areas of the country the army-worm, *Leucania unipuncta*, appeared in countless numbers and destroyed or greatly damaged oats, barley and corn. In early September the imagines were abundant everywhere in the range I travel. With the moths so numerous and generally distributed one would naturally expect the insect to be destructive next year. If such expectation is fortunately not realized, the interesting question arises—what influences have checked it? Is the multiplication of the Tachina fly so rapid as to prevent its appearance in destructive numbers the second year in the same district?

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* Dr. James Fletcher, of Ottawa, writes that the prevailing opinion of arachnologists is that the *Astoma* (or *Atoma*) is the larval form of *Trombidium*, and that in Henshaw's Bibliography of Economic Entomology *Astoma gryllarium* is given as synonymous with *Trombidium locustarum*. Further references are Andrew Murray's "Aptera," pp. 128-129; Riley's "Rocky Mountain Locust," pp. 128-130; Lintner's Eighth Report, 1891, page 180; First Annual Report United States Entomological Commission, pp. 306-311. As a rule the six-legged mites are the larval forms.

The Fall web-worm, *Hyphantria textor*, has been very common in this county. I know two localities where every black ash—of which there was a considerable number of trees—was completely defoliated. Not a vestige of leaf was left. The trees were literally enwebbed from the top to the root. Seizing the webby fabric on the trunk it could be pulled off in strips reaching to the lower branches.

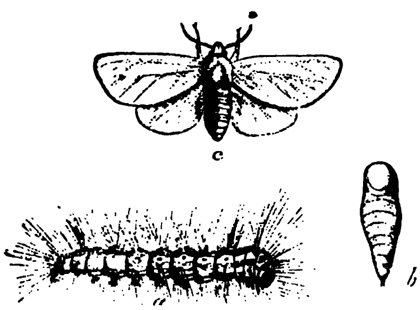

Fig. 8. *a*, worm; *b*, chrysalis; *c*, moth.

The orchard fruits in this country have been unusually free from insect injury. In 1895 fruit was a failure, owing to the heavy frost late in May. Its scarcity caused every apple that escaped to be gathered carefully. None was allowed to remain on the ground. This year all wormy fruit, and indeed much that is not wormy, is left to rot, so abundant is the crop and so insignificant the price for it. Hence the insects will develop without let or hindrance, save from their natural enemies. The abundance of this year's crop points to increased need for spraying next year.

FAILURE OF PEA CROP.

It would be out of place here to speak of fungal and bacterial injuries to crops, etc., to which I give more attention than to insects, but I may refer to the failure of the pea crop in Prince Edward County. Some farmers there find it profitable to raise garden pease for sale to the seedsmen. This year the crop failed; the diseased plants looked as though they were affected by a parasitic fungus. Mr. Craig, the Dominion Horticulturist, kindly sent me a large number of specimens. On many of them I found fungi, all probably saprophytic, not disease producing, but produced in the diseased or dying tissue, and, what is more noteworthy, on many, in fact nearly all the roots I examined, a minute Nematode or Anguillula-like worm. There were not any nodules such as the rose anguillula produces on the roots of that plant in the green-house. Much damage is done to plants in the Southern States by anguillulæ, but it has been thought that the winters in our latitude are too severe for any organism of this class to survive in injurious numbers. The failure of the pea crop in that county needs further investigation. I believe it was due to several causes, one of which was the presence of these nematodes.

PARASITIC FUNGI.

Speaking of fungi naturally leads one to think of the work done in a new and imimportant field, that of artificially controlling injurious insects by vegetable parasitism. Colonies of silk-worm and of the honey bee are occasionally devastated by a muscardine and pebrine and foul-brood respectively, which are fungal and bacterial parasites. It is not unreasonable to suppose that similar parasites may be discovered capable of artificial cultivation which may be introduced among gregarious insects as grasshoppers, army-worm, etc., and used to control them effectively. Prof. Forbes, of Illinois, has experimented extensively upon inoculations of the Chinch bug.

Laboratory experiments have been conducted in Cornell Agricultural Experiment Station by Mr. R. H. Pettit, under the direction of Professor Atkinson, with various parasitic fungi upon several different kinds of insects. Dr. Roland Thaxter has done plendid work on the *Entomophthoreæ*. Prof. Snow, of Kansas, Prof. Webster, of Ohio, and others, have also labored in the same field. So far, while many of the laboratory experiments have been successful and promising, the work in the field has not yet, to my knowledge, reached very satisfactory results.*

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* Since writing the above I am informed by Dr. Bethune that at the Buffalo meeting of the Economic Entomologists, August, 1896, Prof. Webster, of Wooster, Ohio, stated that farmers in the districts of that State badly infested with the chinch-bug had eagerly obtained and used specimens of the pest artificially inoculated with *Sporotrichum* to distribute where chinch-bugs would come in contact with them, and thereby contract and spread the disease. He reported satisfactory and encouraging results.

The subject of entomogenous fungi is too large to enter on here, but it may be of iterest to show specimens of a few of those most commonly met with.

The first is a parasite on the scale insect (*Lecanium* sp.), which I find on oak, ash, nd blue beech. It is called *Cordyceps clavulata* (Schw); the genus is in the same order ith the medicinal ergot or smut of rye. The fungus feeds upon the tissue of the insect, isplacing the latter by its vegetative portion. It matures by producing erect sporohores, $\frac{1}{8}$ to $\frac{1}{4}$ inch long, bearing papillate conical heads. Under each papilla is emedded a perithecium containing numerous sacs or pods called asci, each of these sacs ontains eight long, separate sporidia or "seeds."

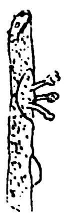


Fig. 9.

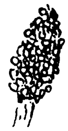


Fig. 10.

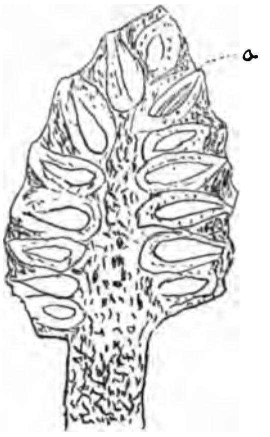
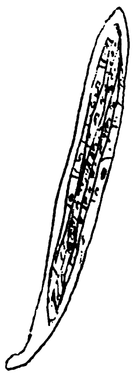


Fig. 11.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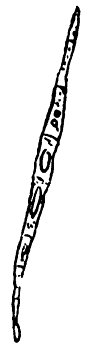


Fig. 13.

Fig. 9.—Twig with two scale insects. One of them killed by *Cordyceps clavulata*, having three sporohores of the fungus.

Fig. 10.—Head of one of the sporophores enlarged.

Fig. 11.—Cross-section of head of sporophore showing the flask-like perithecia greatly enlarged. These erithecia are filled with sacs as indicated at *a*.

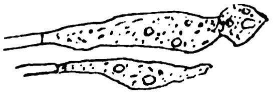
Fig. 12.—A sac or ascus containing eight sporidia still more highly enlarged.

Fig. 13.—A sporidium or "seed" magnified 750 diameters.

The fly-fungus, *Empusa muscæ*, Cohn, belongs to a very different group of fungi. he former is placed in the class with black-knot of the plum tree and the mould on the ooseberry. This has close relationship to the white mildew of the grape, to the peronspora which produces soft rot of the potato, and to that causing a peculiar tinking decomposition of fish. No doubt you have observed dead flies surrounded by whitish halo adhering to a pane of glass. This halo consists of the spores, conidia—nd secondary spores thrown off by the growing fungus from the body of the infected fly.

When one of these living spores gets attached to the under side of a fly's abdomen, t puts out a tube which penetrates the skin and rapidly spreads through the whole body n the manner in which yeast grows through bread, feeding upon the fatty substances rithin the fly. The exhausted fly finally settles, it may be on a pane of glass, there the ungus by abjunction scatters its spores around the body producing that smoky halo to rhich I referred.

Dr. Roland Thaxter in his masterly monograph on the Entomophthoreæ in which he escribes the various known species which affect flies, mosquitoes, gnats, aphides, cicadæ, hrips and lepidopteræ, says ot the house-fly fungus that its occurrence out of doors is an xceptional phenomenon, and that he knew of only two instances. His observation nakes the specimens I have laid on the table the more interesting, as they were collected off leaves and twigs near the edge of Cranberry Lake, in the County of Oxford. (A box containing twenty or thirty olive-colored flies killed by this fungus was passed round for examination.)



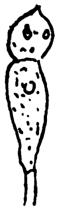


Fig. 14.

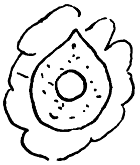


Fig 15.

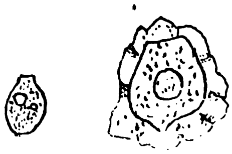


Fig 17.

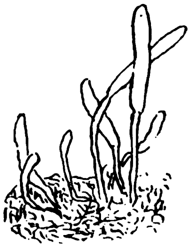


Fig 18.

Figs. 14 and 16.—Conidiophores forming white rings between the segments of the abdomen. Highly enlarged.

Figs. 15 and 17.—Primary and secondary conidia which form the smoky halo seen round the fly adhering to the pane of glass. Highly enlarged.

Fig. 18.—Conidiophores of *Isaria farinosa* slightly enlarged.

Another fungus, or stage of a fungus, doubtless quite common though not frequently observed, bears the name *Isaria*. These specimens which I have here grew upon pupæ, probably of Arctiids, and are labeled *Isaria farinosa*, Fr. They are supposed to be a stage of *Cordyceps*. Out of the insect grew these conspicuous sporophores, ¼ to ½ inch long, orange at base but covered when fresh for two-thirds of their upper part by a white dusty layer of spores which arise from the ends of the threads forming the sporophore. At Cornell, spores from a potato culture of this fungus were painted on the ventral side of seven "woolly-bear" caterpillars; in twenty days the fungus had attacked all but two of them, and in another month one of them had developed showy sporophores like that from which the culture had been taken.

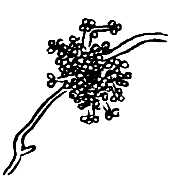


Fig. 19.

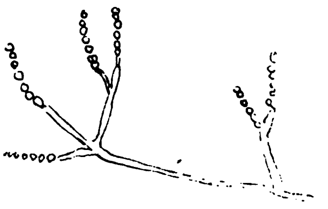


Fig. 20.

Fig. 19.—A thread of *Sporotrichum globuliferum* bearing spores greatly enlarged.

Fig. 20.—A thread of Isaria bearing spores separated from the compact sporophore. Greatly enlarged.

The fungus which has been used for infection experiments with the chinch-bug is known as *Sporotrichum globuliferum*. It was first found on Carabidæ and is somewhat like Isaria in its method of growth. Instead of the filaments being compacted into sporophores they envelop their hosts in a loose white cottony swathing. (An example of sporotrichum on a beetle was exhibited, also larvæ bearing *Isaria*).

ENTOMOLOGICAL LITERATURE.

The President's addresses have usually presented a brief review of the entomological literature of the year. That duty will be discharged this time by Dr. Bethune. I have just a word in reference to two publications that have recently come to these rooms—one, a report of the Gypsy Moth Commission prepared by Drs. Forbush and Fernald,—a volume of over 600 interesting pages, devoted to one injurious insect. I refer to this to show what labor may be involved in studying and combatting even one insect. The labors of the Massachusetts entomologists in controlling the spread of the gypsy moth are a monument to the value of economic entomology.

The other publication to which I refer is a bulletin called "Practical Entomology" by Messrs. Hopkins and Rumsey of the West Virginia Agricultural Experiment Station. It is a veritable *multum in parvo* and although it contains only about 80 pages it keys and classifies the insects injurious to farm and garden crops in a very unique manner. The most inexpert farmer or gardener is led directly to a pretty certain identification of his insect foes and the approved remedies are briefly indicated. I wrote a letter to the authors complimenting them upon their plan of presenting practical entomology to the agriculturist. Director Myers acknowledged the letter and stated that it is their intention to continue this line of practical instruction to the horticultural and other interests and probably finally to publish the work in book form.

TEACHING NATURAL HISTORY IN SCHOOLS.

On every occasion that has offered the opportunity, I have put in a plea for such modification of our school curriculum of studies as would provide for the education of the observing faculties of our children. Training to observe facts, and to relate causes and effects not only affords good mental discipline but is of the highest practical value. We must all to a greater or less extent be experimenters throughout our active lives; hence skill in observing, comparing, relating and judging is necessary to success. Properly conducted nature-study is therefore of very great value. For the purposes of such study local geography, and the phenomena of weather, plant and insect life, furnish the very best material.

The flower and the insect appeal powerfully to the child's interest and while in botany and entomology there are many problems that the greatest observers and thinkers have not answered, yet there are others that even the little kindergartners find a pleasure in solving when the proper method is pursued. At teachers' meetings and at the Central Farmers' Institute I have outlined a course of study pointing out what might be attempted, especially for the benefit of farmers' children in entomology, etc., in each grade. A few years ago Prof. Wm. Saunders read papers here entitled "Entomology for Beginners." He treated in a popular way the life history of the cabbage butterfly, the leopard moth, the polyphemus, the satellite sphinx, the red humped apple-tree caterpillar and the eyed elater.

We need such papers as those—modified so as to treat in an experimental manner the life history of a half-dozen common typical insects—containing practical suggestions on observing their habits, capturing, caging, feeding, and preserving them. The paper might be issued by this Society as a bulletin. The teacher would find additional assistance in such works as Prof. Panton's "*Insect Foes*" and Packard's *Entomology for Beginners*. Besides the educational value and pleasure to the children of such study consider what important practical bearing it would have. Such mistakes as I knew a gardener to make would not then occur. He killed the tomato sphinx larvæ by stamping on them, but those bearing the coccoons of its parasitic ichneumon he carried to the house to be immersed in boiling water to kill the eggs as he thought. Think of it, ignorantly scalding his best helpers!

Last spring I went to the proper committee of the Western Fair Board with the request that it offer prizes or diplomas to schools for exhibits of the life history of injurious insects. Our thanks are due to the committee for compliance with the request as it has shown what can be done by a teacher and his pupils in this line when he seriously addresses himself to the task. I have the exhibits here from school No. 14, N. Dorchester, and Union 5 and 15 London. The teacher in No. 14, Mr. J. W. Atkinson, had no technical knowledge of insects when he set about this work but taking advantage of the presence of the army worm in his section and following a few written suggestions on technique, he caged the larvæ, reared the moths, secured the eggs, and captured several beetles which prey upon the larvæ. What an object lesson this was to the children? How much more interesting, useful and exact their knowledge of metamorphosis having thus observed it, than if they had merely read the account of it in a book, even in a pretty picture-book. I think the result of this effort is well worth publishing. To that end I have had this photograph of the exhibit taken. See opposite page 32. It does not and cannot show the written sketch and the specimens of barley, oats, corn and mangolds damaged by the larvæ, but it will afford suggestions and stimulation to teachers who may see this report.

The exhibit of the squash-bug showing this injurious insect in seven stages from egg to adult males and female with a biographical sketch and specimens of its work on the pumpkin was prepared under the guidance of one of our young members, Mr. Robert Elliott of Plover Mills, in Un. 5 and 15. (The exhibits, written accounts and mounted specimens of the damaged crops, corn, oats, etc., were passed round.)

The report of the Council outlines the work of the Society for the year. The general verdict on its persual will be "Well done.". The only opinion meant to be adverse which I have ever yet heard upon the work of this Society is that too much attention has been paid to American insects and that our pages have shown too much intercourse with the entomologists of the United States. Congress gives to every State in the Union $15,000 annually to devote to experiment station work. To each of these stations are attached one or more practical entomologists. What a large staff of trained workers this liberal policy must tend to produce. Are we to be blind or indifferent to the wealth of investigation and result these men are accomplishing? The potato beetle, the horn fly, the army worm, have to be combatted—in short which of our injurious insects has not to be combatted by the farmers of the northern United States as energetically as by ourselves, indeed it is usually from and through that country they reach us for unfortunately these insects pay no attention to political boundaries nor customs' officers. I believe the Americans as well as the vast majority of our own people realize that entomologically theirs and ours is one country. The Americans have honored two of our members—Dr. Fletcher and Dr. Bethune by electing them in 1889 and 1893 respectively as president of the entomological section of their chief national science association, President Cook at the Indianapolis meeting in 1890, speaking of "our country" said, "by ours I include, of course, our Canadian brothers for we, as scientists know no line of separation." That sentiment is reciprocated here.

American entomologists cordially work with ours for the common good. I remember Prof. Saunders relating that Prof. Lintner, State Entomologist, Albany, N. Y., had enlisted his co-operation to control the gooseberry saw-fly, *Nematus ventricosus*, by sending him parasitized eggs of that species. This is but an instance that might be multiplied. At a meeting in Brooklyn, N. Y., Mr. L. O. Howard, Chief Entomologist at Washington, after highly complimenting the Rev. Dr. Bethune as a Canadian entomologist testified that—in a large measure due to Dr. Fletcher and to Dr. Saunders—economic entomology had been energetically prosecuted in Canada. "Canada" he says "has the man (Dr. Fletcher) and the knowledge but has been hampered by want of funds. The result is that while she has immediately and intelligently adopted the results of researches made in this country she has not been able to lead us in original investigation."

It is foolish to think of entomological areas being demarked by parallels of latitude or even by rivers and lakes. President Saunders in his address in 1882, declared that although belonging to Ontario and sustained in our work mainly by the liberal aid granted us by the Ontario Government, our sphere of usefulness extends throughout the length and breadth of this great Dominion, and also across the lines into the United States. That declaration is true; we can and do help our cousins across the lines and we are helped in return. The close student of the intercourse knows that we get as much or more than we give.

May our entomologists ever keep a watchful eye on the methods and results of their American confreres and continue to be regarded by them as skilful and helpful co-workers, and worthy in the future as in the past to fill places of honor in their national conventions.

Discussion on the Address.

In rising to move a vote of thanks to the President for his very able and interesting address, Dr. Bethune said that he had been very kind in referring in so complimentary a manner to the founders of the society. Many years ago, Dr. William Saunders and the speaker set to work to gather together all those in this Province who were interested in entomology. After a meeting had been called, much assistance was given by Messrs. Croft and Hincks, two professors in the University of Toronto, and Dr. Sangster, who was at the head of the Normal School. Thus a beginning was made, and each year was marked by the addition of more members, and by some good work done. One of the early members was our lamented friend, Mr. John Denton, who had passed away since our last annual meeting, and who was esteemed and respected by every one who knew him. We all missed his kindly presence and the genial hospitality with which he always welcomed the members from a distance. He took the deepest interest in the welfare of the society, and by his exertions and wise counsels did much for its permanent success. The speaker also referred to the loss the society had sustained by the death of Captain Gamble Geddes, who had been an active member for many years and one of the Council representing Toronto Division.

Dr Bethune then spoke of the great value of the President's researches into the life history of parasitic fungi and the practical advantages that may result from them, and referred to the excellent work that was being done in this respect by scientific men in the United States. He had learnt, with much surprise, that objections had been made to the annual reports of the society on the ground that so much attention and space was given to the proceedings of the American Association of Economic Entomologists. In the first place it should be remembered that this association was originated by Dr. Fletcher, of Ottawa, and was organized and held its first meeting in Toronto; it is therefore as much a Canadian as an American society. Furthermore we must all feel that science has no political, geographical, religious or sectional boundaries; it embraces the whole world, and on this continent we know that, while we can sometimes help our American cousins, we are largely indebted to them every year for valuable additions to our knowledge. We who study entomology are especially aware of this. Many noxious insects have come to us across the frontier, paying no respect to political boundaries or custom-house officers, and we have been prepared for their coming and taught how to receive them on their arrival by the experience and the labours of our friends "on the other side." But for this knowledge we should be in an unhappy plight, and while we were trying experiments and studying out the history of the insect, it would be sweeping unchecked over our fields or fruit trees. Surely it is most important that we should take the earliest opportunity possible of giving to our farmers and fruit-growers the experience that has been gained by the various state entomologists and experimental stations scattered over the continent, and afford them information which they would be unlikely otherwise to obtain.

Mr. Fyles, in seconding the vote of thanks, expressed the great delight with which he had listened to the President's address, especially to the part relating to fungi, which opened a wide field of great interest, and he felt personally very grateful to the President for giving such a clear account of the growth of fungi and bringing before the meeting matters with which few of them were familiar.

After the vote of thanks had been put to the meeting and pronounced "carried," amid much applause, the President introduced Professor Panton, of the Ontario Agricultural College at Guelph, whose work and labours were, he said, well known to all who are interested in agriculture and entomology. Prof. Panton, who was very warmly received, said he had great pleasure in being present at this annual meeting of the Entomological Society of Ontario. He had done a good deal himself to disseminate the teachings of the society during the last fifteen years, and each year he had been much interested in reading the reports of its proceedings and researches, but till now he had always been prevented from being present at its meetings. He then proceeded to give the following address:

ENTOMOLOGY FOR RURAL SCHOOLS.

By Professor J. Hoyes Panton.

It is a gratifying thing to observe, that within the past few years, there has been a growing desire, on the part of farmers, to know more of the teachings of science, as it bears upon agriculture. It has been the privilege of the writer to attend many Farmers' Institutes since their commencement. At first, any topic of a scientific nature excited but little interest. The great majority cared little to hear about a subject, which seemed entirely of a theoretical nature; and, far removed from the truly practical work of the farm. However, that condition has passed away, and the average farmer now feels, that a knowledge of the teachings of science lies at the very foundation of success in the pursuit of agriculture.

He has learned that science is simply systematized knowledge; that its principles are founded upon the facts which are discovered daily on the farm, or in the orchard. In reality, the farmer is one of the most scientific of men, and is surrounded by conditions especially fitted to develop observation, comparison, and method in work. The Farmers' Institutes have done a great work in awakening farmers to the necessity of a study of science, as it relates to their work. But we believe, a greater future is in store for the people of rural districts, when their children shall have become acquainted with the teachings of science, by giving some attention to its study, while, at the common school, in their neighbourhood. With a view to direct attention to how the study of economic entomology might be taught in country schools, this address is given before the Entomological Society of Ontario. The subject of entomology is one well fitted for study in rural schools; specimens are readily obtained for illustration, and, it is especially suited to interest young minds.

This can be accomplished without additional expense in purchasing books, and with little withdrawal of time from the time-table.

The writer would suggest a series of talks upon the subject the last hour on Friday afternoon, during a portion of the summer months, when insects are most numerous.

Especial attention should be directed to such insects as are beneficial, or injurious, invariably having the pupils collect specimens and contribute them so as to form a collection that would represent the economic entomology of the section.

The following might be taken as an outline of several talks, before specific forms of insects were discussed, and with a little study on the part of any teacher, would supply valuable information:

I. *Definition of an Insect—Nature of the Mouth—Life History.*

An insect, Fig. 21, may be described as having three well-marked divisions: head, thorax, and abdomen; one pair of antennæ (feelers), three pairs of legs, usually two pairs of wings; respiration by means of tube-like structures (*tracheæ*), simple and compound eyes and jointed limbs. Most insects undergo metamorphosis—that is, pass through a series of well-marked changes in their development from the egg to the adult condition.

Among insects we find two typical mouths: the masticatory or biting, characteristic of beetles and the larvæ of many insects; and the suctorial or sucking, represented in butterflies and plant-lice. A knowledge of these facts becomes of importance in the application of insecticides. Insects with *masticatory* mouths can be readily poisoned by applying some poison, such as Paris green, to their food; but those possessing a *suctorial* mouth must be treated with a substance that kills by contact and not by being introduced into the digestive system. Such insecticides as *Kerosene Emulsion* and *Pyrethrum* powder are suitable for this mode of treatment. Thus, by knowing the nature of mouths, we are able to suggest what substance is likely to be effective in destroying insects.

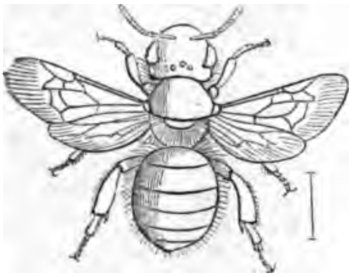


Fig. 21.

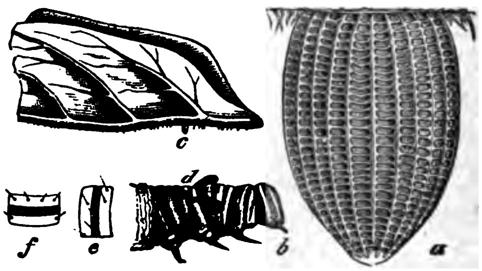


Fig. 22.

The development of an insect is represented by four stages—*egg*, *larva*, *pupa*, *imago*

The following figures illustrate the different stages of the Archippus butterfly, a red and black species which is familiar to every one. Fig. 22, *a* represents an egg, highly magnified, and *c* the egg of the natural size on the underside of a milkweed leaf; *b* shews the head and anterior segments of the caterpillar before its last moult, at *d* are the long fleshy horns, which at this stage are tucked under the skin; *e* and *f* shew the arrangement of the bristles on the segments.

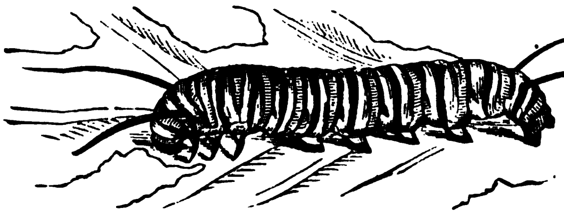


Fig. 23.

Fig. 23 represents the caterpillar which is handsomely marked with black, yellow and white transverse stripes.

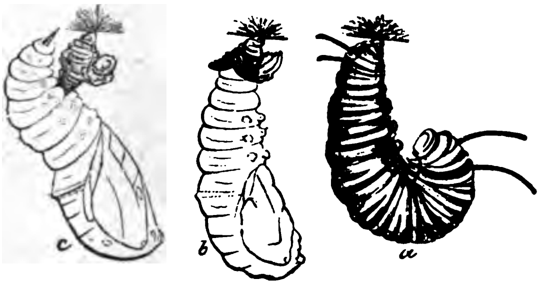


Fig. 24.

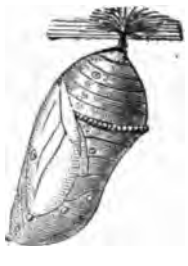


Fig. 25.

Fig. 24, shews the caterpillar at *a* suspended from a little button of silk preparatory to changing into a chrysalis; at *b* and *c* it is making further developments, till it becomes a lovely green pupa decorated with a band of golden spots, Fig. 25.

From this emerges in course of time the splendid butterfly, Fig. 26, which soars so gracefully through the summer air.

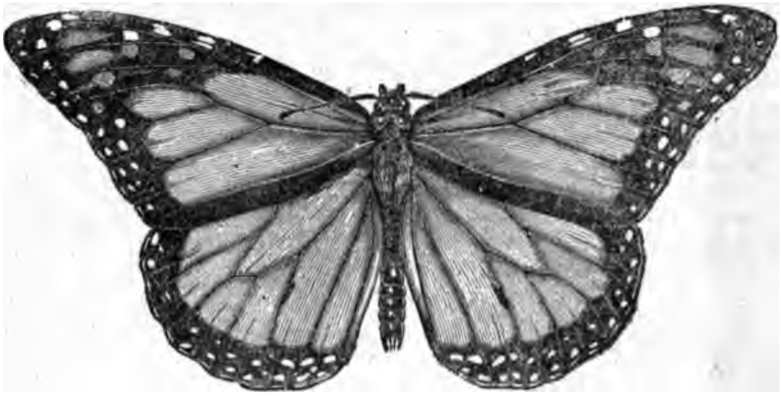


Fig. 26.

The *larva* (*larva*, a mask) is frequently without external organs and has a biting mouth ; hence, it is a great feeder and usually very destructive to vegetation. The larval condition continues from two to six weeks in most; but there are some in which it is more than a year, *e.g.*, the wire worm, white grub, and some "borers."

Pupa (*pupa*, a doll). This is generally a resting condition, which, in summer, usually lasts but a short time (about two weeks) ; but if entered in autumn, continues till the next spring. The term *chrysalis* (*chrysos*, gold) is often applied to this stage in butterflies, because in some it is dotted with golden spots. In most moths a *cocoon* is woven around the pupa. Nymph is applied to the young of such as do not undergo complete metamorphosis in development ; in such the young are much the same in appearance as the adult, but smaller, and usually wingless ; *e g.*, grasshoppers, bugs, etc.

Imago (*imago*, an image). This term is applied to the perfect insect, which is often harmless, as far as feeding upon vegetation is concerned.

The following names show some of the common terms applied to these stages in some orders of insects :

Larva	Pupa	Imago.
Borer, grub	"	Beetle.
Maggot	"	Fly.
Caterpillar or worm	Cocoon	Moth.
" "	Chrysalis	Butterfly.
Nymph	Nymph	Grasshopper.

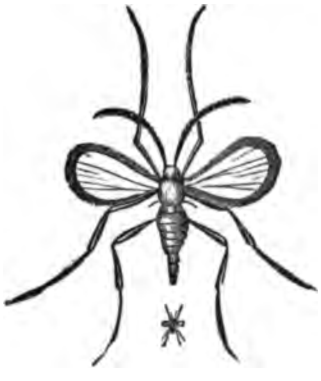


Fig. 27.

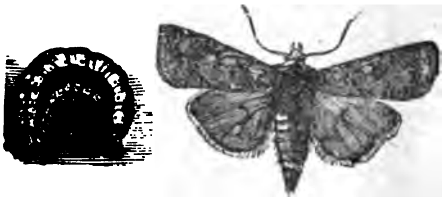
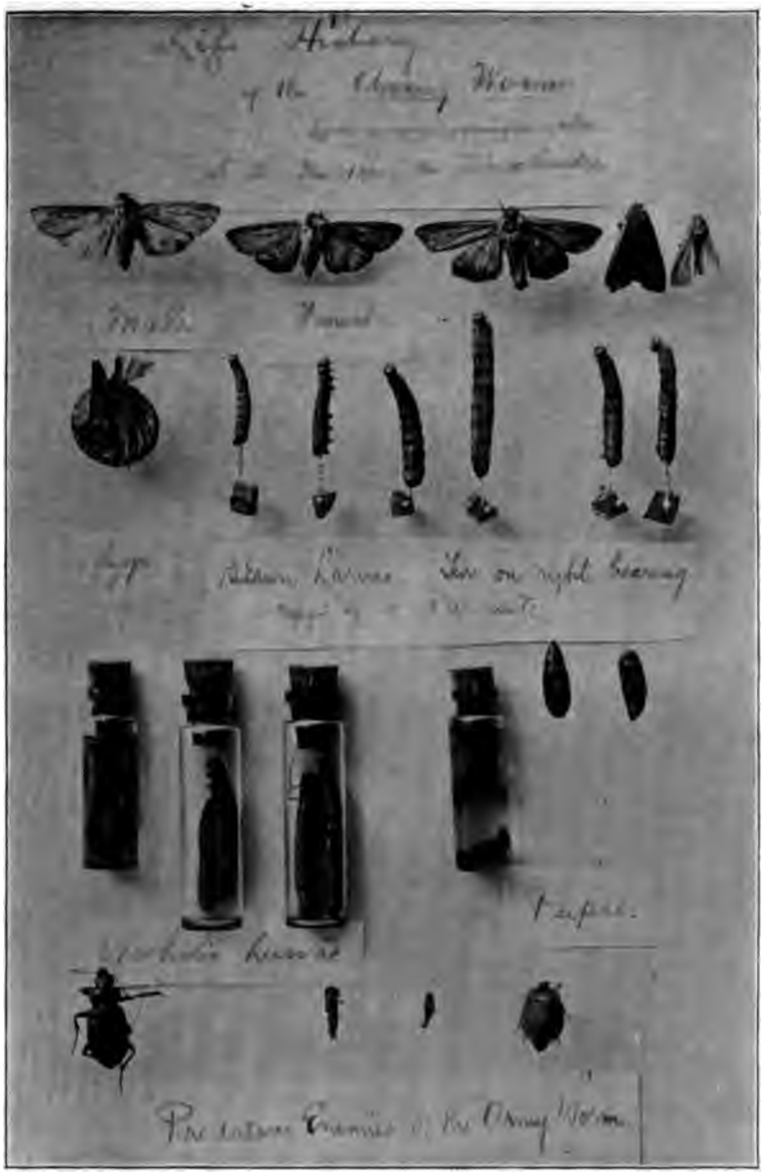


Fig. 28.

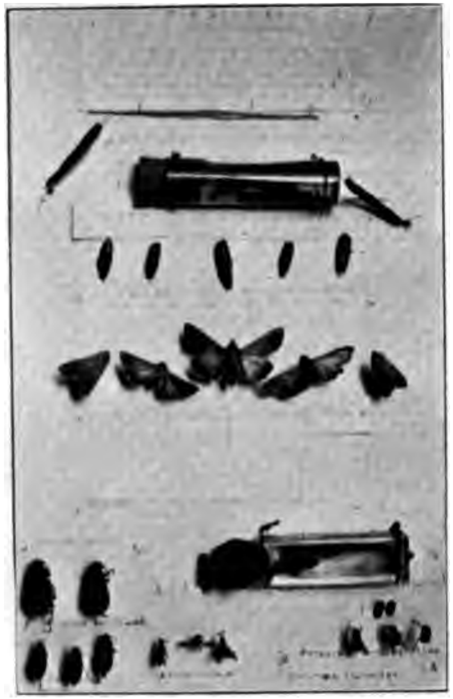
II.—Insects may be Beneficial or Injurious.

Beneficial.—The bee (honey) ; silkworm (silk) ; cochineal (dye) ; ichneumon (feeds on injurious insects).

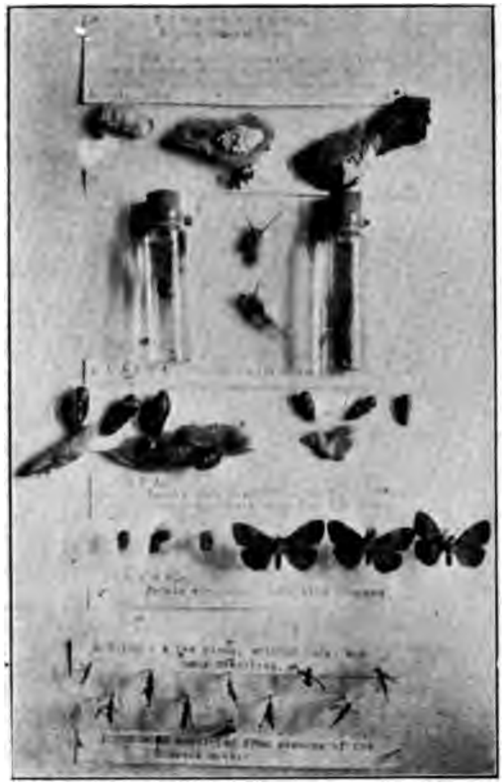
Injurious.—Those affecting the products of the field (midges, Fig. 27, the wheat midge, etc.) ; the garden (cut-worms, Fig. 28, etc.) ; the orchard (borers, Fig. 29, etc.)



School exhibit of the life-history of the army worm (see page 28).



A case illustrating the Life History
of the Army Worm.



A case illustrating the Life History
of the Tussock Moth.

III.—Remedies.

1. *Natural enemies.* *a. Birds.* Many investigations have been carried on to learn what insectivorous birds are useful in assisting man to keep in check his insect foes.

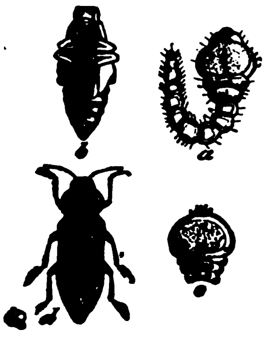


Fig. 29.

Thousands of birds have been shot, and the contents of their stomachs examined so as to ascertain with accuracy if the insects eaten were injurious. In some cases as many beneficial insects were devoured as harmful. The result of careful examination into the subject has been to consider the birds named in the following list as benefactors to the farmer, the fruit grower, and the gardener, and should, as far as possible, be protected and permitted to increase in number :—

King bird, pewee, night-hawk, swallow, whip poor-will, American redstart, yellow-billed cuckoo, blue bird, white-bellied nuthatch, red-headed woodpecker, high-holder, hairy woodpecker, downy woodpecker, golden warbler, red-eyed greenlet, yellow-throated greenlet, Wilson's thrush, brown thrush, cat bird, red-winged blackbird, crow blackbird, oriole, meadow lark, indigo bird, song sparrow, grass finch, chipping sparrow, chewink, purple finch, snow-bird, American goldfinch, horned lark, wren, chickadee, golden-crowned kinglet ruby-crowned kinglet, and American creeper.

(*b*) *Mammals.* Moles, bats, shrews, racoons and skunks. (See Mr. Elliott's paper on Insectivorous Mammals.)

(*c*) *Insects.* Among the most beneficial insects we find the following in the different orders :

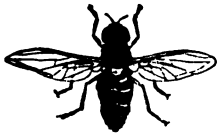


Fig. 30.

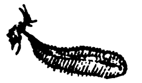


Fig. 31.

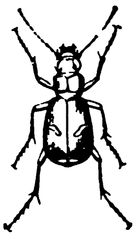


Fig. 32.

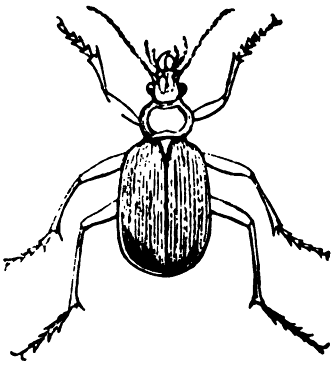


Fig. 33.

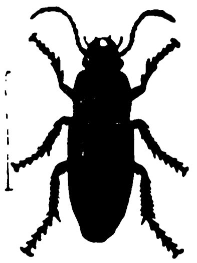


Fig. 34.

Order Diptera.—Syrphus fly (Figs. 30 and 31); Tachina fly.

O. Coleoptera.—Cicindela (tiger beetles) (Fig. 32); Calosoma (Fig. 33); Harpalus (Fig. 34) (ground beetles); Coccinella (lady-birds) (Figs. 35 and 36).

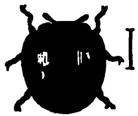


Fig. 35.

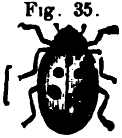


Fig. 36.

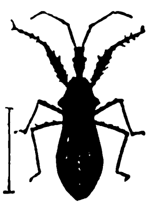


Fig. 37.

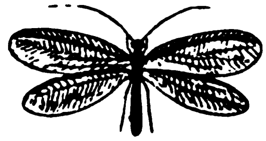


Fig. 38.

O. Hemiptera—Reduvius, Arma (soldier bugs) (Fig. 37).

O. Neuroptera.—Chrysopa (laced-winged flies) (Fig. 38).

O. Hymenoptera.—Vespa (wasps) (Fig. 39); Chrysis (cuckoo flies), Ichneumons, (Fig. 40).

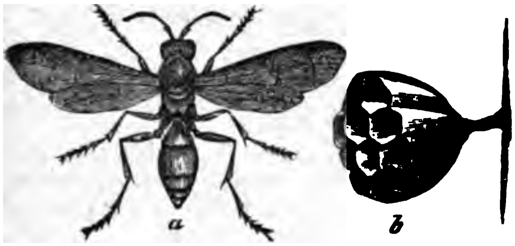


Fig. 39.

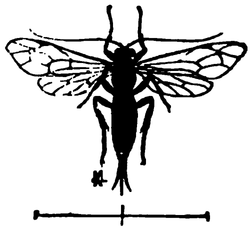


Fig. 40.

The above insects are of great importance in keeping the injurious insects upon which they prey in check. The ichneumons are most valuable in this respect. They are very numerous, and prey on many injurious insects, by depositing eggs in the larval forms. These eggs give rise to larval ichneumons that feed upon their host, which finally dies. About this time the ichneumons are developed and escape as perfect insects. The lady-birds are destroyers of plant lice; ground beetles prey on the potato beetle and several caterpillars, and the tiger beetles are great devourers of several species of insects.

(*d*) *Plants.* Some plants in the lowest orders do good service in destroying insects by being parasitic. Some (Empusa) attack the flies in autumn; some (Sporotrichum) the dreaded chinch bug, which is sometimes a serious pest in various parts of the United States; while the white grub has among its destroyers the parasitic fungus Cordyceps.

2. *Insecticides (substances used for killing insects), Gas, Paris Green and Kerosene Emulsion.*

Poisonous gas, generated in tents placed over shrubs and trees affected by scale insects, etc.

Carbon Bisulphide.—This colourless liquid is a most effectual remedy to get rid of insects in granaries, but great care requires to be taken as it is very inflammable and explosive, and may lead to serious results if any fire is brought near; even a cigar or pipe used where the vapor is being evolved may prove disastrous. It readily volatilizes; the vapor is heavier than air and is deadly to insect life. In using it the liquid may be placed in a small shallow vessel and put on the top of the grain, in bins or barrels. These are covered so as to keep in the vapor, which sinks down through the grain, destroying insect life wherever it comes in contact with it. After the operation is over the grain will lose all odor in a short time if exposed to the air. Some prefer taking a wad of cotton or tow, saturating it with the liquid, then plunging it into the middle of the bin and leaving it. Two or three bunches thus placed among the grain will soon kill all such pests as are found in it. One ounce is about sufficient for two bushels of grain.

Paris Green.—(Arsenite of copper, containing 50-60 per cent. of arsenic.) This is applied dry or in solution. In the dry form it should be mixed with 50 to 100 parts of plaster, wood ashes, flour or air-slacked lime and dusted upon the affected plants. The form in solution is usually one pound of Paris green to 200 gallons of water; but if the foilage is tender, 250 to 300 gallons of water may be used. This is the usual strength applied upon the plum and peach. As the green powder does not dissolve it requires to be kept thoroughly mixed by constant stirring. One pound of lime to every 100 gallons will prevent injury to the foliage. The Paris green should be first made into a thin paste, in a small quantity of water, and then added to the full amount of water.

Kerosene Emulsion.—This is a mixture of coal oil and water.

Riley-Hubbard Emulsion.—Consists of half-a-pound of hard soap in one gallon of water. Boil till dissolved, and then add two gallons of coal oil, and mix thoroughly for about five minutes. When properly mixed it will adhere to glass without oiliness. This can be done by forcing it through the nozzle of a force-pump repeatedly until the mixture appears complete. It will then form a creamy mass which thickens into a jelly-like substance on cooling. In using dilute with nine parts of soft water. This form is very commonly used and is easily prepared. If the foliage is very tender the emulsion must be more dilute, fifteen to twenty parts water.

Whale oil soap is better than the common hard soap, especially if the emulsion is to be kept for some time. Soft soap may be used instead of hard, using one quart. Where the water is very *hard* sour milk may be taken; in that case you require only to mix the coal oil (two gallons) and milk (one gallon) to get the emulsion, the soap not being required. This emulsion is liable to spoil if kept long. Kerosene emulsion is a most successful remedy for plant lice and scale insects.

3. *Barriers.*

Using barriers to check the progress of injurious forms, such as chinch bug, army worm, etc.

4. *Traps, Baits.*

Entrapping the insects, such as codling moth, canker worm and cut worms.

(a) Trap the larvæ crawling up and down the trunk by bands of rough cloth or tow, under which they will crawl and spin their cocoons.

(b) Use means to trap the climbing females. This may be done by putting a band of some material smeared with tar around the tree, or using what are known as "tree protectors," a sort of funnel-shaped structure that is fastened around the tree three or four feet from the ground; these prevent the females from getting up the tree.

(c) In gardens poisoned baits may be successfully used, such as small bunches of clover, cabbage leaves, etc., dipped in Paris green solution (one pound Paris green to one hundred gallons water), and placed near the attacked plants. The cut worms will feed upon these and be destroyed.

5. *Agricultural.*

1. A proper rotation, so as to avoid sowing crops in fields where they are likely to be destroyed by insects.

2. Using good seed, *e.g.*, peas without bugs.

3. Varying the seeding time so as to have the plants either too late or too early to be attacked by injurious insects.

4. Summer fallowing, so as to starve the insects and expose them to birds, etc.

5. Drainage. Some insects prefer moist soil, in such cases drainage will render it unfit for them.

6. Fall plowing is injurious to many insects especially the wire worm.

7. Manure. The use of manure helps the plants and enables them to overcome insect attacks. Vigorous plants are more likely to escape than sickly ones.

If such an outline were followed, a portion being taken for each talk, the leading principles of economic entomology would soon become familiar. Then, particular insects might be studied, and the pupils be encouraged to work out the life history of some. Starting with the egg, and observing the different stages passed until the perfect insect is reached.

Would it not be an excellent plan to influence the directors of county fairs to offer prizes for the best collections of beneficial and injurious insects, or for the best case illustrating the development of an insect from the egg to the imago?

If our teachers, in rural schools, were to follow a course something like what has been outlined in this address, who could estimate the influence upon the rising generation of farmers? Teachers desirous to take up this work could readily secure bulletins and books that would serve their purpose admirably. The writer would not have pupils get books, but to depend entirely upon the instructions of the teacher and their own observations in the orchard and upon the farm.

Such study of the great Book of Nature would result in developing observation in young minds, something that is aided very little in our system of education among rural schools. No faculty in the young mind is so ready for development as observation, and yet how little is done to assist it. Nature furnishes material on every side in the country, and surely we should take advantage of it and early train our young to be close observers.

We have no doubt that the study of such subjects would increase the attractiveness of farm life, and serve to keep many a boy upon the farm who, with such surroundings as we find to-day, seeks the shadowy allurements of a home among overcrowded centres in town and city.

We hope the day is not far distant when the teachings of nature will be better known in country sections, and that the boys and girls of our farming districts will see more in farm life than what some bemoan as drudgery; that they will see in it that which tends to health, peace, independence, and an ideal home; and that while they eagerly learn *how* a thing should be done, they will also know the reason *why*, so that practice and science, the handmaids of agriculture, will be more closely associated than in the past.

In the discussion which followed the reading of the paper, Dr. Bethune said that as he had been a school-master for six and twenty years he could well appreciate all that had been said, both by the President and Professor Panton, on the subject of teaching entomology in schools, especially in those situated in rural districts. Any one who tried it would be pleased and surprised to find how readily people in general are interested in subjects of this kind, even when they have not paid any attention to them before. And in the case of children, who are always curious about anything that attracts their attention, it is an easy matter to excite their interest and lead them to observe for themselves some of the wonders and beauties of Nature. He thought that the plan of devoting the last hour on Friday afternoons in country schools to talks upon Natural History was an admirable one, and he hoped that it would be widely adopted. He had formerly made use of this hour in a similar manner himself, but of late years the large increase in the number of subjects for the Matriculation Examination had rendered it impossible to spare the time. He thought that if country life could be made more interesting to the young people fewer of them would be so eager to abandon their farms and rush into the towns and cities.

Mr. John S. Pearce spoke of the valuable work of the Society, which he did not think was as generally known as it should be. He thought that more should be done, especially by paragraphs in the newspapers, to draw the attention of the public to the great benefits which the Society has been for years conferring upon farmers, fruit-growers and gardeners throughout the Dominion.

Mr. John Law moved a vote of thanks to Professor Panton for his excellent address to which he had listened with great pleasure. This was seconded by Dr. Woolverton, and carried unanimously. In putting it to the meeting the President (Mr. Dearness) spoke on the importance of training the powers of observation of children by bringing subjects of nature before them. The object would then become the teacher, and the school-teacher the interpreter.

The Rev. T. W. Fyles then read the following paper :

THE IMPORTANCE OF ENTOMOLOGICAL STUDIES TO AN AGRICULTURAL AND FRUIT-GROWING COMMUNITY.

Rev. Thomas W. Fyles, F.L.S., South Quebec.

It is wonderful proof of the wisdom and goodness of God that this earth, which He hath given to the children of men,* is so fitted and prepared that it affords scope and claim for the exercise of man's powers, and that man himself is so constituted that the employment of those powers is conducive to his well-being and enjoyment of life.

So true is this that though the fiat has gone forth—"Thorns and thistles shall the earth bring forth to thee. In the sweat of thy face shalt thou eat bread," it is also written, "Thou shalt eat the labour of thine hands. O well is thee, and happy shalt thou be."

In the vegetable kingdom materials in such great variety are so abundantly furnished, and man finds that he can, to so great an extent, select, transplant, modify and improve the plants producing them, for the supply of his necessities and gratification of his tastes, that he is stimulated to exertion, and comes to realize that he is, in a humble way, a co-worker with God ; and his work is ennobled to him by the thought.

And not only do men, whose very living depends upon their endeavours in the field, the garden, the orchard and the vine-yard, take an interest in rural occupations and their rewards ; "The king himself"—says the wise man—"is served by the field" ; and the devotees of Ceres, Flora and Pomona are to be found as well among the highly gifted and trained leaders of the public as among the hard-handed sons of toil. The most eminent statesman can take pleasure in a *primrose* or an *orchid.* The great Lord Bacon spoke of Horticulture as the "purest of human pleasures ; and the "Judicious Hooker," one of England's most learned and thoughtful divines, desired no higher preferment than a country cure, in which he might see God's gifts spring from the bosom of the mother earth.

It is the general interest in the productions of the soil, and whatever affects those productions, that is the *raison d' être* of the scientific associations fostered by our Department of Agriculture.

The task I have set myself is to shew the importance of Entomological studies to those who take an interest in the cultivation of the soil.

Entomology has to deal with "the locust, the caterpillar, and the palmer-worm"—God's "great army." So vast is this army that—to use the words of Dr. Lintner, the State Entomologist of New York—"it has been truthfully said that insects have established a kind of universal empire over the earth and its inhabitants. Minute as many of them are, and insignificant in size to other than naturalists, yet in combination they have desolated countries and brought famine and pestilence in their train." (First Report, p. 2.) Happily the hordes are duly apportioned. Each natural division of territory has its share. And there is such a marvellous arrangement of checks and counter-checks operating upon them that, as a rule, every kind is held in proper subjection.

The intentional or accidental transportation of an injurious species beyond the sphere of the operations of its natural foes sometimes occasions disaster.

Of the injuries wrought by imported insects we have had instances never to be forgotten, in the ravages of the Hessian Fly (*Cecidomyia destructor*, Say), the Cabbage Butterfly (*Pieris rapœ*, Linn.), the Colorado Potato Beetle (*Doryphora decem-lineata*, Say), the Larch Saw fly (*Nematus Erichsonii*, Hartig), the Gypsy Moth (*Ocneria dispar*, Linn.), and the Fluted Scale (*Iceryia Purchasi*, Maskell).

It must not, however, be supposed that all insects are injurious. Many species must be ranked among the cultivator's friends. Indeed, of the 25,000 named species of North American insects about 8,000 only can be regarded as pests.

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* Ps. cxv, 16.

Some species are injurious in one stage of their existence and useful at another.

Our Hawk-Moths by dispersing pollen act beneficially for the fertilization of blossoms; but if unchecked increase were allowed them, their caterpillars would become terrible pests, and would destroy not only our fruit-trees but many of our shade and ornamental trees also. Their numbers are however kept down by various species of ichneumons belonging to the genera Ophion, Cryptus, Microgaster, Apanteles, etc. I have seen as many as 150 parasitic grubs issue from one larva of *Sphinx Kalmiæ*, A. & S. It can easily be conceived that foes so numerous and so deadly would soon exterminate the Sphinges altogether.*

This would be a pity for, as I have said, the moths of the family perform a useful part. They are moreover very beautiful, and

> "A thing of beauty is a joy forever."—*Keats.*

But the checks are met by counter-checks. Of those 150 grubs that I have mentioned not more than two or three escaped the attacks of a secondary parasite, *Pteromalus tabacum*, Fitch. This last named insect is a brilliant little object that once seen can hardly be forgotten.

People are familiar with the idea of one grub feeding inside another grub; but it is not so generally known that there are insects that pass their early stages and attain perfection inside the eggs of other insects. Ashmead in his valuable work on the Proctotrypidæ, published in 1893 by the Smithsonian Institution, has given descriptions of forty-one such insects.

Then there are numerous kinds of ground-beetles, lady-birds, syrphus-flies, soldier-flies, dragon-flies, etc., predaceous on other sorts, and therefore beneficial to man.

The first point I make then is this:—*A knowledge of Entomology is important that men may rightly distinguish between their insect friends and their insect foes.*

In a paper which I had the honour to read before the Fruit Growers' Convention at Ottawa, I showed the important work done by Humble Bees in the cross fertilization of blossoms. These insects are so entirely beneficial that some of their kind have been—with a sort of grim propriety—transported to New Zealand to labour there for the public good.

But, at the very time that the Humble Bees are operating in the orchard for the fruit grower's benefit, there are a number of other insects at work that do a vast amount of harm, namely, the Bud-worms, Canker-worms, Leaf-rollers, etc. *The great remedy against all these hurtful insects is arsenical spraying.* But if this spraying be delayed till the blossoms are opened the nectaries will become clogged with the arsenite, and though the instinct of the bees may lead them to shun the poisoned blossoms, the good those insects would do will be left undone. *The first spraying should be given before the flower-buds are opened; the second after the fruit is fairly set.*

The Ontario Legislature passed a law in April, 1890, which says:

"Sec. 1. No person in spraying or sprinkling fruit trees during the period within which such trees are in full bloom shall use, or cause to be used, any mixture containing Paris green, or any other poisonous substance injurious to bees."

Promptitude in dealing with in urious insects is always of the utmost importance.

A patch of aphides neglected will spread, and spread, till it covers a tree—a little one becoming a thousand.

The apple tree Aphis (*Aphis mali*, Fab.) lays its eggs in the fall; and Mr. F. M. Webster suggests that apple trees should be sprayed in winter (see 24th Rep. of the Ent.

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* Let us suppose that the whole number of grubs mentioned would produce perfect insects, and that half of these would be females; then let us see what the natural and unchecked increase of these would be at the end of five years. A little figuring will shew that it would amount to the enormous number of 4,746,093,750.

Soc. of Ont., p. 90) for the destruction of the eggs. We should have to take an unusually mild time for such a purpose in this country! I dare say, however, that a spraying early in November, or early in the spring would be beneficial. Kerosene emulsion, made by violently agitating a mixture of two gallons of kerosene and one gallon of hot soap solution is prescribed as the remedy for use. It should be diluted with nine gallons of water (Lintner's 5th Rep., p. 161).

Late in the fall, or on favourable days in winter, the fruit grower can do good work by examining his trees and removing the egg masses of various species of injurious insects. A trained eye can readily detect the eggs of *Clisiocampa Americana*, Harris, Fig. 41. *Orgyia nova*, Fitch, *O. leucostigma*, A. & S., and the cocoons of *Platysamia Cecropia*, Linn., *Telea Polyphemus*, Linn., *Callosamia Promethea*, Drury, Fig. 42. etc. But in removing such as these he should be careful not to destroy the clustered cocoons of microgasters, nor the downy masses of those of *Apanteles longicornis*, Prov.—a species that is parasitic in the Tent caterpillars—for these insects are among his most valuable friends.

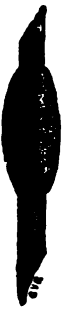


Fig. 41.

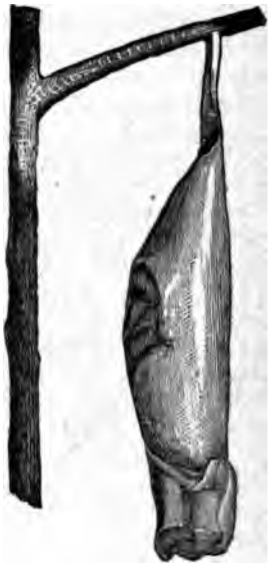


Fig. 42.

The destruction of every hibernated Potato Beetle in the early spring is the destruction of an incipient host. The potato plants should be sprinkled with Paris green as soon as they appear above ground.

A friend of mine when the beetles first invaded the province, and before it was quite known how they should be dealt with, broke up a piece of land in the very centre of his extensive farm, and planted it with potatoes, hoping that its isolation would secure him a good crop. One early day he went to the enclosure to see if the potato plants were shewing themselves. They were not; but to his disgust there was, to use his own words, "a durned potato-bug sitting on the fence, and awaiting for them to appear." His action in regard to that individual was both prompt and effective!

Gooseberry and currant bushes should be gone over with white hellebore *as soon as the leaf-buds begin to open.*

The eggs of many of our hurtful species are laid in patches, as for instance those of *Datana ministra*, Drury, which produce the yellow-necked apple tree caterpillars, and those of *Œdemasia concinna*, A. & S., which produce the Red-humped apple tree caterpillars, Fig. 43. The young broods of these may be found in July, each brood feeding on the *under side* of a leaf. The plucking and destroying of a leaf and its burden is easily accomplished.

The Round headed Borer of the apple tree (*Saperda candida*, Fab.), Fig. 44, is a troublesome pest. Its native food-plants are the thorn, the moosemissa and the shadbush, but it takes far too readily to the apple tree. The perfect beetle appears in June,

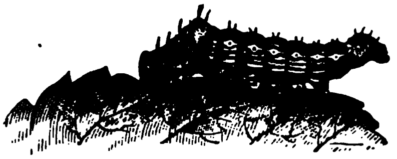


Fig. 43.

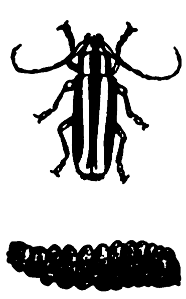


Fig. 44.

and lays its eggs in the end of that month and in July. In June then is the time for the fruit grower to go over the stems of his young apple trees with a brush and diluted soft soap. He can give them a scrubbing at the same time if he likes. Sir Joseph Banks freed his apple trees from the American Blight (*Erisoma lanigera*, Hans,) by the use of the scrubbing brush alone (Kirby and Spence's Entomology, Letter VI.). The second point I make is:—THE STUDY OF ENTOMOLOGY IS NECESSARY THAT THE CULTIVATOR MAY KNOW HOW AND WHEN TO DEAL WITH HIS INSECT FOES.

The study of Entomology is profitable. What harm and loss have been averted by the making known of insecticides and how to use them! *But greater good is sometimes done by calling in the aid of friends than by direct attacks upon foes.*

The introduction of the Australian Lady-bird (*Vedalia cardinalis*, Mulsant) has probably saved the orange groves of California from extinction.

I have no doubt that if the parasite (*Diplosis grassator*, Fyles) which keeps down the numbers of the Philloxera in this country had been carried over to Europe it would have saved many a vine-yard that has disappeared.

The late Professor Riley introduced from Europe the species *Microgaster glomeratus*, which is a check upon the cabbage worm (*Pieris rapœ*, Linn.). The insect is figured and described in Wood's "Insects at Home," pp. 325-7. Wood tells us that "so rapidly does it multiply that after watching its progress from the larva to maturity, it seems strange that a single cabbage white butterfly should be found in the country." * * * "If a hundred cabbage caterpillars be captured, there will be only one or two which do not contain the larvæ of the microgaster."

Mr. A. D. Hopkins, of the West Virginia Agricultural Experiment Station, has lately introduced the European predaceous beetle, *Clerus formicarius*, Linn, to the United States; and it is thought that this insect will check the destruction of the spruce forests which has proceeded to such an alarming extent in that country. The clerid larva is the natural foe of the bark-boring and wood-boring larvæ. It searches them out and devours them with avidity.

As *Clerus formicarius* is a new importation to this continent, and is at present little known, a short description of it may be acceptable. The beetle is about three-eighths of an inch in length. Its head and the fore part of its thorax are black. The after part of the thorax and the base of the wing-covers are brick red. The remaining portions of the wing-covers are black crossed by two somewhat wavy, snow white lines.

The name Kleros was given by Aristotle to certain larvæ found in bee-hives. The trivial name *formicarius* was given to this species by Linnæus because of the ant-like form of the beetle. (See Wood's "Insects at Home," p. 138).

A knowledge of Entomology was necessary for the understanding of the habits of these predaceous and parasitic insects, and for placing them where they might work to man's advantage. And this bringing about of good by the direction of natural agents is only in its inception. As our knowledge increases we shall, in all probability, be able to direct and control forces that are at present but little understood. My third point is:—THE STUDY OF ENTOMOLOGY IS NECESSARY THAT THE AGRICULTURIST AND FRUIT GROWER MAY MAKE THE MOST OF THEIR INSECT FRIENDS.

The Americans—a practical people—are fully alive to the importance of entomological research. Their division of entomology in the Department of Agriculture; their national museum; their experimental stations dotted all over the Union: their numerous scientific commissions, with their reports and bulletins—all bear witness to this fact.

Our own authorities do not mean to be behind hand. The establishment of experimental farms, the encouragement given to scientific and economic societies, farmers' clubs and institutes, etc., the printing and distributing of reports upon practical subjects, betoken an enlightened policy on their part.

But notwithstanding all that has been accomplished, sufficient care has not, I think, been taken to reach the young.

In 1887, in a paper read before the Teachers' Convention at Sherbrooke, I advocated the cultivation in schools of a taste for natural history. The means I recommended to teachers were:

I. Conversations on natural objects; informal lessons; extempore sermons on texts from the book of nature.

II. The formation of school museums, libraries and gardens.

III. The giving of formal object lessons, each complete in itself, and bearing upon the purpose in view.

Examples of peripatetic lessons on natural history may be found in Gosse's "Canadian Naturalist" (which is now, I am sorry to say, out of print) and in "Country Walks of a Naturalist with his Children," Groombridge & Sons, London.

Hints for the formation of school museums may be found in a work written by a brother of a former rector of Quebec, and published by the S. P. C. K., viz.,—"The Story of our Museum," by the Rev. Henry Houseman, A.K.C.

We need some one to do for Canada what Miss Ormerod is doing for England to popularize PRACTICAL ENTOMOLOGY.

We need a hand-book on this subject, written after the model of that useful work "Spotton's High School Botany," for use in our public schools.

We need school wall-sheets, representing the most important of our insect friends and insect foes in their different stages, and giving a few brief particulars concerning them.

But it is time I brought this paper to a close. I will only say in conclusion that I know of no study more fascinating than that of entomology. It deals with objects of such exceeding beauty; the life histories it makes known are so marvellous that they tell like fairy tales; and, above all, the revelations that it makes to us of the Divine power, wisdom and goodness so lift our thoughts from earth to heaven that we are ready to exclaim with the Psalmist, "Oh Lord, how manifold are Thy works, in wisdom hast Thou made them all; the earth is full of Thy riches." Ps. civ. 24.

Mr. Wm. Lochead spoke very highly of Mr. Fyles's papers in the annual reports, which he always read with great interest and pleasure. He thought that the popularizing of the study of entomology in our schools would form another step in the progress and advancement of Canada. He then gave an account of the work that was carried on at Cornell University in connection with entomology and described the advantages to be gained from the lectures, and the practical work in the "Insectary," from such able teachers as Professor Comstock and Mr. Slingerland.

Mr. J. Law moved a vote of thanks to Mr. Fyles for his valuable paper, and was seconded by Mr. W. Scarrow, who spoke of the lack of mental interest in farmers, which might, he thought, be developed by education in entomology and the study of other natural objects, and in this way farm-work would become a pleasure instead of mere drudgery.

A very humorous paper was then read by Mr. Law, in which he gave amusing descriptions of the experience he had with ants and other insect pests during a residence in Cuba; he related an attack which he witnessed of a large spider on a humming-bird, and spoke of the size and beauty of the fire-flies and the profusion and variety of insect life in the tropics.

The meeting adjourned at 10.30 p.m.

THURSDAY, October 22nd.

MORNING SESSION.

The society met at 9.30 o'clock, the President occupying the chair, and proceeded with the reception of the reports of the several sections of the society and other matters of a business character.

The following report of the Geological Section was read by its secretary, Mr. John Law:—

REPORT OF THE GEOLOGICAL SECTION OF THE ENTOMOLOGICAL SOCIETY FOR THE YEAR 1895-6.

The members of this section beg to submit the following report for the past year:

Regular meetings were held weekly during the year, with a fair attendance. There has been no great increase of membership, but we look forward to our future place of meeting in the new building of the Y. M. C. A. as a means of stirring up our members to increased action in matters relating to the mineral wealth of our country and the welfare of the local section.

Additions have been made from time to time to our individual collections obtained from trips to outside places during the season. Our hopes for forming a central collection have not yet materialized owing to the failure of the effort to obtain the only rooms suitable for that purpose in the new public library building. This Section is pleased to state, however, that a collection of minerals has been presented to the free library, through the influence of Sir John Carling, by the Dominion Government. It is now accessible to our members, having been recently arranged and classified by the chairman of the section; this is putting into effect what was suggested in our last year's report, viz., "That it would be a great advantage to students of mineralogy if some steps could be taken by which the small number of geological and natural history societies in the Province could be provided with suitable collections of accurately named specimens of the chief economic minerals of the Dominion." A collection of minerals at the Western University is also available.

A number of places of geological interest have been visited by one or more of our members during the past season. A stroll through the Niagara district from Grimbsy to Hamilton afforded a collection of fossils from the prevailing rocks in that vicinity, viz., Niagara, Clinton, Medina, the upper Silurian formation. Other places visited were Owen Sound, Kettle and Stony Points (Lake Huron), Forest, St. Thomas, Sault Ste. Marie, Petosky, St. Ignace and Mackinac Island (Michigan), and Bruce Mines on the north channel.

Collections were made from each of these locations, affording the section plenty of new material for the coming winter's work. Valuable papers have been read from time to time before the section on natural history, astronomy and physiology. Some four to five lectures were also given on psychological subjects by the Rev. Mr. Falling.

A number of second year students of the Western University are also taking up the study of geology and mineralogy with the section.

Signed on behalf of the Geological Section by

S. WOOLVERTON, Chairman.

JOHN LAW, Secretary.

REPORT OF THE BOTANICAL SECTION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

In presenting their annual report the Botanical Section have pleasure in stating that the work of the year has been on the whole satisfactory and encouraging.

The meetings have been well attended, interesting and profitable, the new members especially showing an unusual interest in the work.

Meetings were held regularly every Saturday from the 1st May till the middle of July, after that the absence of many members on holiday trips and other uncontrollable circumstances interfered much with our meetings.

The work of the section was arranged so that the more advanced was taken one Saturday, and instruction classes in the more elementary work the next Saturday, the senior members taking turns in directing the examination of types of the common orders collected by the members.

The outings this year were mainly to localities near the city—one exception being a very pleasant trip to Woodstock and neighborhood, where the section were very hospitably entertained by Mr. Thos. P. Hart of that district.

Rare specimens obtained were *Orchis rotundifolia* and *Ophioglossum vulgatum*.

It is believed that the removal to more commodious rooms in the new Y. M. C. A. building will place the section as well as the society and their objects more prominently before the citizens, and result in a greatly increased membership, and consequently usefulness of both.

The section, while congratulating its ex-secretary, Mr. W. T. McClement, M.A., on his appointment to an important position in the Armour Institute, Chicago, regrets his removal from London. When he left he had tabulated the flora of London and environs as far as the Compositæ. This important work will be carried on by the section during the coming season.

A. HOTSON, M.D., Secretary.

REPORT OF THE MICROSCOPICAL SECTION OF THE ENTOMOLOGICAL SOCIETY.

Under the leadership of Mr. Rennie, the Microscopical section has had a year of continued success. The interest of members has kept them diligent in the good work. Notwithstanding the drawbacks consequent upon the poor position of our meeting place, the attendance has been well sustained. We think that in no year have we had more interesting subjects and never have they been presented with greater ability.

Meetings began on October, 11th, and were held each alternate week till April, 17th, when this section closed its meetings in favor of the Botanical, these two sections covering the year between them. We had but one meeting open to the public. This was well attended and general satisfaction was expressed at the many wonderful and beautiful objects under the microscopes.

The subjects studied during the year were as follows:

Desmids.—Their history, structure, distribution and classification, with drawings. These were illustrated by a large variety of specimens. Led by the Secretary.

Crystallography.—Specially as it applies to minerals, with specimens viewed both with and without polarized light. Led by Dr. Wolverton.

The Perisporiaceae.—Practical classification by members. Led by the Secretary.

Chemical Staining of Vegetable Tissues. Led by Dr. Hotson.

Mosses.—Their history and dissection. Alternation of Generations, etc. Led by W. T. McClement, M.A.

Bacteriology. Led by Dr. Neu.

Photo-micrography. Led by Mr. Rennie, who had apparatus present and produced a very fine photo-micrograph of a small insect.

Seeds and their microscopical appearance. Led by Mr. Balkwill.

The relations between Gymnosperms, Cryptogams and Angiosperms. Led by Prof. Dearness.

Animal Hairs.—The significance of their structure, accompanied by a large number of mounts. Led by Prof. W. E. Saunders.

This section has suffered during the year by the loss of two of its active members, Mr. J. M. Denton whose removal by death we all deeply mourn, and Mr. W. T. McClement, M.A., whose home is now in Chicago.

We look out upon another year with anticipations of greater usefulness than we yet have had. The new rooms which we are to occupy will give the Microscopists an opportunity, such as they never have had, of coming under the public eye. It is the intention of this Section to infuse renewed zeal into their work. The wonders the microscope reveals as well as its delights are almost unknown to the public, and it is our purpose to make our meetings more popular during the fall and winter months.

JAS. H. BOWMAN,
Secretary.

The following paper was then read by Professor Panton, who prefaced his remarks by suggesting that a paper should be written by some one connected with the Society setting forth the advantages of the study of Economic Entomology. He spoke also of the necessity of making the work of the Society better known throughout the country and advised the publication of an abstract of the Annual Report in the daily papers. He also recommended that the conductors of county exhibitions should be urged to offer prizes for the best life-history of injurious insects, with specimens illustrating its various stages and modes of operation.

TWO INSECT PESTS OF 1896.

BY PROFESSOR J. HOYES PANTON.

During July of 1896, the attention of the public was, almost, daily directed to a newspaper item referring, either to the "Army Worm" or "Tussock Moth."

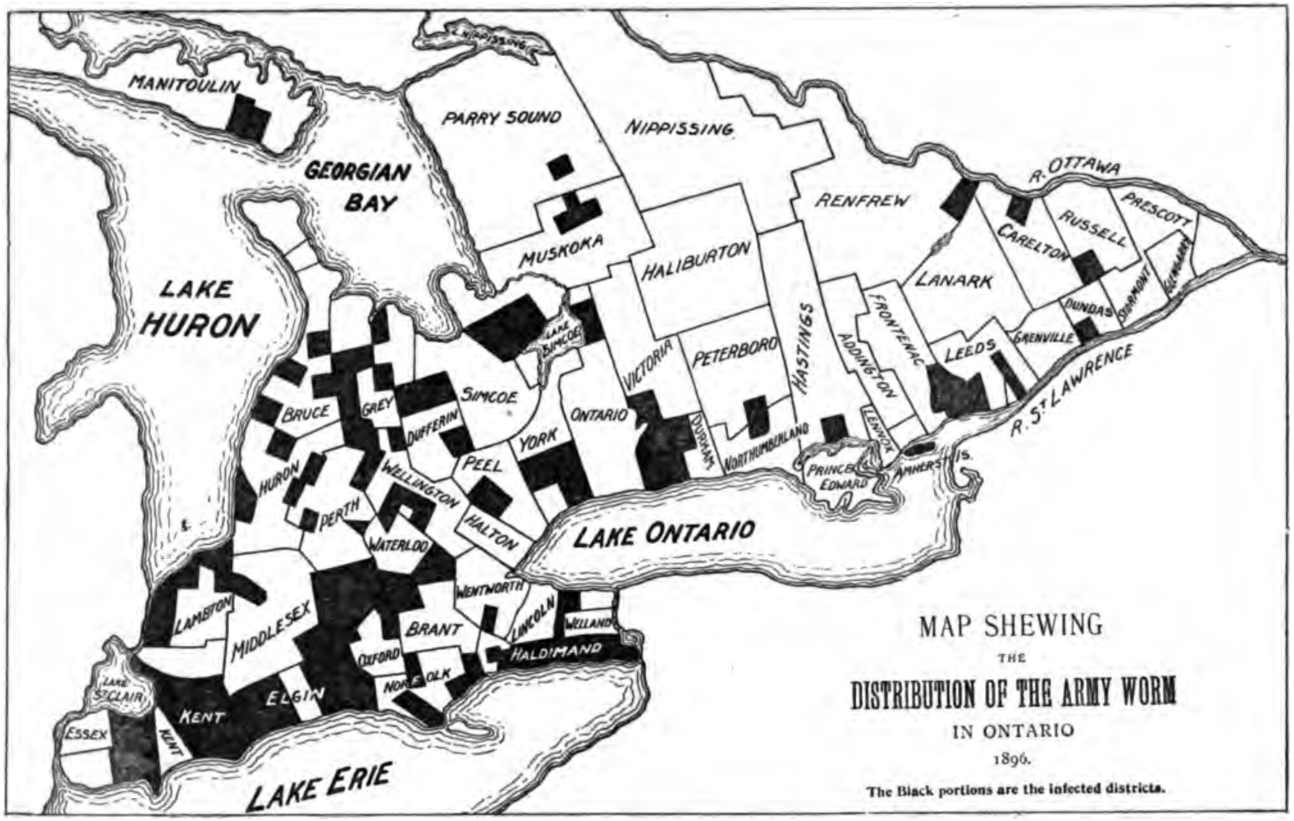
The former appeared in many parts of the Province or Ontario; and, in some places, destroyed considerable grain; the latter, was confined to the City of Toronto; where it did much damage to ornamental trees in different parts of the city. The writer having had the opportunity of visiting several of the infested districts, has thought it expedient to place before the Entomological Society of Ontario the results of his investigations.

THE ARMY WORM.

Leucania unipuncta.

We find the army worm reported as present in the township of Eldon, Victoria county, in August 1833, and, common in many places throughout Ontario Province in 1861.

In July, 1894, it did considerable damage in the counties of Lambton and Victoria.



MAP SHEWING

THE

DISTRIBUTION OF THE ARMY WORM

IN ONTARIO

1896.

The Black portions are the infected districts.

The first notice received at the Agricultural College of its appearance in the Province of Ontario this season, was, in a letter from Marshville, county of Welland, dated July 3rd. On that date, Mr. J. Reavley, living near Marshville, sent some of the worms and a letter describing the attack. The writer visited Mr. Reavley's farm on July 9th, and several others in the townships of Wainfleet, and Humberstone the next day. Throughout the month, letters were daily received, announcing its arrival at different places throughout the Province of Ontario. On the 8th of July, the caterpillars appeared in an oat-field at the Agricultural College, by the 11th, they were very numerous, and reached their maximum on the 15th. From that date a perceptible decrease was daily observed, so, that by the 18th, only a few remained. They began to pass into the pupa stage on the 14th, and, the first moth was observed on 29th of July. Circulars were then sent out, with a view to learn something of the distribution of the army worm at this time; the damage done by it; the means employed to check its progress; and the length of time the caterpillars continued. About 450 replies were received from different townships, throughout the Province.

The accompanying map shows the distribution of this insect pest in Ontario during 1896.

The counties reported as infested are as follows:

Essex (5); *Kent* (8); *Elgin* (6); Norfolk (3); *Haldimand* (4); *Welland* (4); Lincoln (1); Wentworth (1); Peel (1); York (3); Ontario (1); Durham (3); Northumberland (1); Hastings (1); Lennox (1); Frontenac (2); Leeds (4); Dundas (1); Russel (1); Carleton (1); Renfrew (2); Parry Sound (1); Muskoka (5); *Simcoe* (6); *Grey* (6); *Bruce* (5); *Huron* (5); *Lambton* (7); Middlesex (4); Oxford (5); Waterloo (2); *Wellington* (5); Perth (3); Cardwell (1); Dufferin (3); Victoria (1); Peterboro (2); Algoma (1); Manitoulin (2); 39 counties and 118 townships.

The counties written in italics are referred to by observers, as suffering considerable loss. The figures after each county indicate the number of townships reported as infested. In many places the damage was slight, as the worms were too late in arriving to do much harm, owing to the advanced condition of the crops attacked. Early sowing is evidently favorable to an escape from disastrous results by an invasion of this pest. Of the crops attacked, oats suffered most; they seem to be a very attractive food for this caterpillar.

From a count made of crops reported attacked, 58 per cent. were oats, 20 per cent. corn, 16 per cent. wheat, and 5 per cent barley. Some observers report a loss of 50 per cent. in oat-fields, while in most of the other cases the damage was comparatively slight. There were a few cases reported in which almost the whole crop was destroyed. In one oatfield at the college 50 per cent. of the crop was destroyed. In this case the worms were in all parts of the field before being discovered, and no measures could be adopted to stop their ravages. In most cases the attack did not continue longer than two weeks, in several, it lasted but a few days, and very seldom lasted longer than three weeks.

Several worms are known as the "army worm," but the true one is that which has appeared in so many parts of Ontario during the month of July, 1896. It seems also to have been common in several parts of the United States about the same time.

A despatch in one of our daily papers, dated, Washington, July 16th, reads: "Reports to the agricultural department indicate great ravages by the army worm, in all states from Maine to Wisconsin. The pests have been particularly destructive in New York, Massachusetts and Pennslyvania; there is no doubt that the losses will foot up into the millions." In New York State it appeared in 48 counties, and is reported, as the worst invasion in the history of the state. They were, also, common in Ohio and Illinois.

As grain crops were well advanced before its arrival, in many places of Ontario, the damage done was much less than it might have been. The attack, though in many counties, was usually confined to small areas in each case, so that on the whole, the loss was not great.

The army worm (figures 45 and 46) is not at all a rare insect, and, from time to time, appears in Canada and the Northern States. We find it referred to as far back as 1743, 1861 is known as, "the army worm year," in the United States. During that year it received considerable attention and study. In 1869, it was quite common, also in 1872; 1875 was a bad year, and in 1880 it attracted much attention. The years 1861, 1875, 1880, are those in which the insect seems to have demanded most attention.

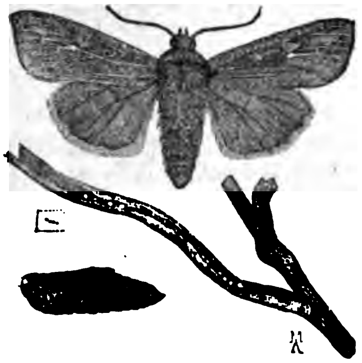


Fig. 45. Eggs, larva, pupa, imago of the army worm (*Leucania unipuncta*).

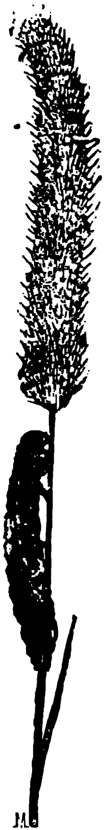


Fig. 46.

The moths are hatched from small, round white, *eggs* laid on wild, or cultivated grasses, and sometimes on grain along the inner base of the blades, where they are doubled, or, between the stalk and its surrounding sheath. The rankest tufts of grass seem to be preferred, but, in some cases, the eggs are found on pieces of cornstalk, and they have been found upon spring and winter grain.

In one of the worst attacked oat fields, at the College, there were many old cornstalks from last year's crop; these, likely, afforded a suitable place for eggs, and this explains the sudden appearance of the caterpillars in all parts of it. This field was the first attacked, and from it many of the catterpillars appeared to have come, in this they were not confined to the edges, as was usually the case in the other fields. The eggs appear to be laid in the evening, or early night. They are deposited in rows, 15 to 20 in a row, on the folded leaf, which serves to conceal them. One female may deposit from 500 to 700 eggs, and seldom takes longer than two or three nights to do so.

The eggs hatch in about a week after being laid. The young caterpillars, in the first stage, can drop by means of a thread, and move with a loop-like motion. At this time, they are of a light greenish color, and thus resemble the plants on which they feed, and escape the notice of their enemies. The *larva* passes through five moults, at intervals of three or four days until it reaches the sixth stage, and is fully developed in about four weeks. The caterpillar is about one and a half inches in length, of a dark gray color, with blackish stripes, and numerous white lines along the back. In many specimens examined by the writer, comparatively few were light colored, until about the close of the attack, and then, the light ones were much more common. Some claim that the dark color is due to exposure. The length of time before complete development of the larva is reached depends a great deal upon temperature, and may vary from 16 to 28 days.

The mid-summer brood usually takes a shorter time than that of the fall. During the day they avoid the rays of the sun by hiding under clods, pieces of boards, chips, etc., and about 5 p. m. they emerge to feed.

In making observations about noon with Mr. Reavley near Marshville, we were surprised that so few worms could be seen at that hour, in a field badly attacked.

But on turning over sods among the oats, we found them in great numbers. We counted over 30 occupying a space no larger than the hand, and, in some parts, more than 50 to the square foot.

In a small patch of late oats on the Reavley farm scarcely a blade was left. The worms abandoned the ripening oats near by, and congregated upon the patch of late oats, no doubt, because they were more succulent.

Every stalk had from one to five worms upon it, and many were eaten to within three inches of the ground. They feed chiefly during the night, and sometimes in cloudy weather. Where they are in great numbers, they make a peculiar sound, which can be heard distinctly, while they are feeding, and cutting off the stalks and heads of grain. Under ordinary conditions, they do not travel, but live much as many other species of the cut worm family do (Noctuidae) to which they belong feeding by night, and hiding by day. However when food becomes scarce, they then undertake to march for new feeding grounds.

They stop at no obstacle, death only will make them halt. A piggery at the college impeded their progress for some days. They never attempted to go around it, but in vain tried to scale its walls, and kept constantly dropping, yet always ready to try the ascent again.

From observations made, as to this rate of travel, while crossing the lane between two fields they were seen to move two feet a minute (40 yards per hour.)

With us they usually appeared active from 4 o'clock p. m., and after that continued to move in great numbers, in all directions, and not in a definite line of march. While feeding, they devoured the leaves and then nipped off the head, which falling to the ground was no longer touched. In attacking some bearded wheat they nibbled off the awns, and only partially fed upon the grain. Oats, timothy, wheat, rye, and barley are their favorite plants; they also feed readily on corn, if young and tender; but they seem to have no inclination for any plants not in the order *gramineae* unless forced by hunger. In a hay field, they will leave the clover and devour every plant of timothy. Several of our fields had excellent crops of young clover; these were left untouched, while the oats and wheat were continually fed upon. In bringing some caterpillars from Humberstone, pea plants were put in the box with them for food, but they were scarcely touched in two days.

The following are results reached during our observations regarding the plants upon which they feed, oats, barley, wheat, and corn they readily devoured.

Clover. This was eaten very sparingly and was left if wheat or oats were introduced into the boxes containing caterpillars. Clover was put in the boxes on Monday, by Tuesday night it was hardly touched, but they began to feed upon it on Wednesday. They ate it, only when nothing more attractive was obtainable.

Lucerne. This seemed less attractive and was not touched until Thursday. Clover, beans and lucerne were put in the same box; all were avoided at first, but, as hunger increased, the beans were first eaten, then clover, and lucerne last. Beans in the box were not touched till Wednesday.

Peas. They were not touched for two days. In a field sown with oats and pease, the latter were not attacked, as long as the oats remained.

Turnips. These were left untouched for a day; as soon as a leaf of corn was put in the box, the turnips were at once deserted. A turnip field bordered one of the infested oat fields; the caterpillars in leaving the latter passed through the former without feeding upon a single plant.

Potatoes, were left untouched in the boxes.

Mangels adjoining one of the invaded fields escaped damage, though caterpillars were constantly passing over and among the plants. In the boxes they were slightly nibbled.

Beets remained untouched for three days.

Buckwheat was taken after a day's fast, when nothing else was presented; but as soon as corn was added they immediately left the buckwheat to feed upon it.

Carrots escaped for a day, but in two days were fairly well eaten. They would not touch carrots in the presence of grass or corn.

Cucumber vines were preferred to beans, and were almost as readily eaten as some corn leaves.

Celery was continually avoided, and the worms began to devour one another before they would feed upon it.

Maple leaves were avoided, but some apple were sparingly fed upon, after two day's fast.

Grape leaves were taken, when no other food was present.

Strawberry leaves remained untouched till the third day.

Currant leaves were avoided for three days and then eaten, but sparingly.

Canadian thistles remained untouched.

When no food was put in the boxes containing caterpillars, in 24 hours they began to devour one another. Frequently in boxes containing unattractive food, heads were found among the leaves, these no doubt belonged to bodies that had been devoured by the survivors.

From these experiments, it would seem that the food of the Army worm is largely restricted to the *gramineæ*, and that they will not feed upon plants from the *leguminosæ* and some other orders unless pressed by hunger. Consequently, there is little fear of any other farm crop being attacked than oats, wheat, timothy, rye, barley and corn.

Having become fully developed caterpillars at the end of three or four weeks from the time of being hatched, they pass into the ground, just below the surface or under stones, clods, etc., and enter the *pupa* stage. In a field at the College many pupa cases were found in cracks in the soil.

This condition lasts two weeks, and then the perfect insect (*imago*) emerges from its pupa case.

The moth is fawn-colored, with a small white spot near the centre of each front wing. The wings when spread measure one and a half inches across.

It conceals itself during the day and begins to fly towards night. Many could be seen flying around the electric lights in Guelph about the second week in August. The female has a more pointed abdomen than the male and her antennæ are smoother, and less hairy, than those of the male.

The moths feeding on flowers are more likely to be found near low ground, and hence they appear to come from such places. There appear to be three generations represented in a season or two broods in a year; the first wintering as larvæ, the second forming the "Armies," and the third larvæ derived from these after the imago has been developed; the last wintering as larvæ. The army worm usually winters in the larval form, but sometimes as the moth.

In the vicinity of our fields at Guelph, where the caterpillars were so numerous, we have as yet (Oct. 18th) failed to find any of the second brood.

The following stages (taken from Riley's report 1882) in the life history of an Army worm gives a good idea of the length of time that elapses in passing from the *egg* to *imago*. *Eggs* laid May 4th, hatched May 11th, 1st moult May 17th, 2nd moult May 20th, 3rd moult May 23rd, 4th moult May 26th, 5th moult May 29th: *pupa* June 2nd, *imago* June 17th.

At the College the first caterpillars were observed on the 8th of July; on the 9th there was a preceptible increase, 12th a marked increase; 13th large numbers; 14th, 15th still very numerous; on the 16th a perceptible decrease; 17th the decrease quite marked; 18th, 19th comparatively few; 20th only a few stragglers could be seen, and, most of these, were light colored. Towards the close of the attack, a bacterial disease seemed to destroy some of them. It is a matter of surprise to many how these caterpillars appear and disappear so suddenly, but a little reflection upon their life history explains the mystery.

Hidden in the grass by day, and feeding at night, they escape observation. If one or more dry seasons come, they multiply rapidly. Large numbers winter in the larval condition, and during the following spring moths appear and lay many eggs, which hatch and give rise to innumerable caterpillars which from a scarcity of food are forced to "march" and thus become suddenly conspicuous. These develop, pass into the ground to enter the pupa stage, and thus disappear suddenly.

Dry weather seems favourable for their development. Consequently a dry season, followed by a mild winter, and a dry summer, as in 1895, and 1896, supplied conditions very suitable for increase of the army worm in many parts of Ontario.

Having referred to the distribution, and life history of this insect, and some of our investigations in connection with it, we may now direct attention to some of the means by which it is, and may be prevented from being a source of alarm.

Natural remedies. The army worm has many enemies; nearly all insectivorous birds relish it as a sweet morsel, and are ready to feed upon it the moment it becomes conspicuous. In Guelph, this season, the English sparrows congregated in great numbers, where the caterpillars were numerous, and fed voraciously upon them. In some parts of the United States the bobolink is called the army worm bird.

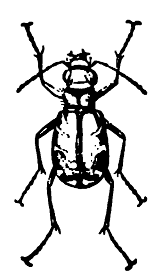


Fig. 47.
Tiger Beetle.

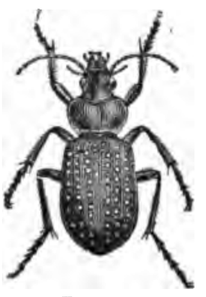


Fig. 48.
(*Calosoma calidum.*)
[After Riley]

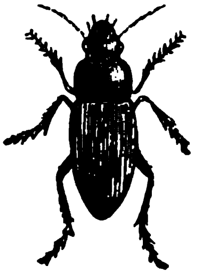


Fig. 49.
Ground beetle (*Harpalus caliginosus*)
[After Riley.]

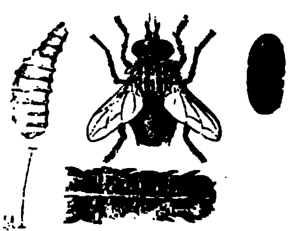


Fig. 50.
Nemoraea leucaniae.

The ground beetles, *Calosoma calidum*, fig 48, and *Harpalus calignosus*, fig 49, especially the former, were very numerous in the infested fields. Tiger beetles (*Cincin-*

delida) fig 47, also prey upon them. But, probably, one of the greatest insect friends to assist in destroying the army worm is the red tailed tachina fly (*Nemoræa leucaniæ*) fig. 50. In the infested fields of Wainfleet near Marshville, the writer found many of the caterpillars, bearing the eggs of this insect upon them. In some cases, several eggs upon a caterpillar, and the flies themselves buzzing around. At the college we seldom saw more than a single egg upon a caterpillar and this was usually near the head, in a position not easily reached by the worm to tear it off. We succeeded in developing quite a number of the flies. Shortly after the egg is deposited it hatches, and the small white grub bores into the worm (host) and feeds upon it, developing at the expense of the host's life. At first, none of the minute white eggs of the fly could be seen, though many caterpillars were examined, but in a few days, some were observed which indicated that a benefactor had arrived. This beneficial insect resembles a large house fly, but has a red tip at the end of the body. The first one appeared in our breeding cages Aug. 4th; the first army worm moth July 29th. Some observers have seen the yellow-tailed tachina fly (*Tachina flavicauda*) preying upon the army worm.

While developing the caterpillars we succeeded in securing several specimens of *Ichneumon leucaniæ*, another parasite, and one of *Ophion purgatus*.

Altogether, investigators have found some twenty different species of insects that attack and assist greatly in destroying the army worm.

It will thus be seen that the moment these insects emerge from their hiding places in grass fields, they are pursued by a host of relentless foes in the form of birds, predaceous beetles and parasitic flies.

Artificial remedies. 1. As this insect breeds largely in rank grass, such as is seen bordering swamps, it is well, where practicable, to burn such in the fall or spring. Clean cultivation, and the keeping of fence corners, etc., clean, should be followed, as far as possible.

2. Where the worm has appeared its progress may be stopped by plowing a furrow with its perpendicular side next the field to be protected, or a ditch may be dug in the same position. Holes dug at intervals of ten to fifteen feet, in the furrow or ditch will be useful in catching the worms, failing to climb the sides, and wandering aimlessly along the furrow. The worms collected in the furrow or ditch may be destroyed as follows: (a) Plowing a furrow, so as to bury them; (b) Sprinkling coal oil upon them; (c) Scattering straw over them and firing it; (d) Dragging a heavy pole along the ditch.

3. Where Paris green may be safely used a strong mixture (one pound to seventy-five gallons water) sprayed upon the plants likely to be first attacked will be effective. Windrows of green oats sprinkled in this way in the line of march will destroy myriads as they feed upon their favorite food. At the College immense numbers were destroyed in this way in a short time. By actual count made by the writer July 18th, 2,560 dead worms lay on a single square foot beneath the windrows.

4. Sometimes, conditions are such, that great numbers may be crushed under a roller.

5. Windrows of straw sometimes afford a place of concealment for the worms, and may be fired so as to destroy many beneath them.

6. Some recommend spraying several times a day with kerosene emulsion, a strip of ground over which the insects are passing.

Frequent reference has been made in newspapers to the use of salt or lime as an effectual barrier to their progress. We experimented with both, and found that in each case the worms moved over and through the lime and salt, apparently without the least difficulty.

TUSSOCK MOTH.

Orgyia leucostigma.

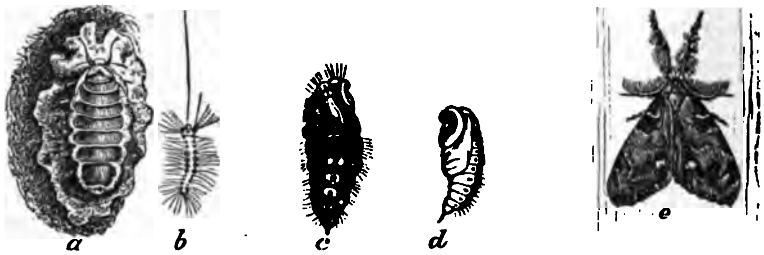
The Tussock moth is another insect pest which has attracted considerable attention during July, 1896. Though not widespread in its attack, it has occupied considerable space in the newspapers.

Its ravages have been largely confined to the defoliation of shade trees in the city of Toronto, and hence, appearing at a place where important daily papers are published, it received much notice.

Although in Toronto this caterpillar confined itself largely to an attack upon the horse-chestnut trees, yet it feeds upon the foliage of other trees. It has been found doing much injury to the elm and apple, and also feeding upon the plum, pear, maple, oak, walnut, butternut, locust and spruce. Few, if any trees, are exempt from its attack. It made its appearance in Toronto about July 1st, and remained for about three weeks, during which time it defoliated many of the horse-chestnut trees on Jarvis street, College avenue and in some other parts of the city. The writer visited the city July 27th, and had an opportunity to investigate its ravages.

This insect is readily identified in all its stages—*egg*, *larva*, *pupa* and *imago*.

Fig. 51. Fig. 52. Fig. 53. Fig. 54.



Orgyia leucostigma. *a* Adult female on cocoon. *b* Young larva. *c* Female pupa. *d* Male pupa. *e* Adult male (after Riley).

The eggs appear in masses (400-700) covered with a froth-like substance, that dries and hardens upon them, and serves to protect them from injury by the weather (rain), predaceous insects, and even birds. This covering is very white, and thus renders the egg masses quite conspicuous at a considerable distance where they are deposited. These masses may be found on the trunk of the trees, in crevices of the bark, on the larger limbs, or in sheltered spots, such as fence boards and on bunches of dead leaves hanging upon the tree. In Toronto, the trunks of the horse-chestnut trees attacked presented in some cases quite a spotted appearance, from the innumerable white masses of eggs and cocoons attached to the bark.

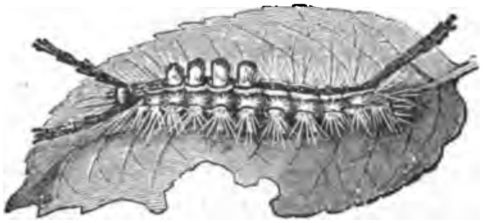


Fig. 55. *O. leucostigma*, full-grown larva (after Riley).

As soon as the *eggs* hatch, tiny *caterpillars* (fig. 51, *b*) make their appearance (usually about June), and, as development proceeds, they pass through a series of molts, three—(one a week). After the third, the larva (fig. 55) presents all the striking characters which make it so readily identified. The head, and the spots on the 9th and 10th segments are a bright red color; the back is black, with yellow lines along the sides; the body is sparsely covered with long, pale yellow hairs, giving the caterpillars a yellowish appearance. Four cream colored dense tufts of hair form a row upon the back of the 4th, 5th, 6th and 7th segments; while from each side of the head a long black tuft extends forward, and a single one projects backward from the posterior end of the body.

The young caterpillars soon after hatching scatter over the trees, feeding upon the leaves; when disturbed, they drop by a silken thread to the ground, wander about, many ascending the tree again.

Having reached full development, which takes about six weeks, during which they have reached a little over an inch in length, they enter the *pupa* stage (figs. 52 and 53), which lasts less than two weeks. The cocoon of the male is whitish, or yellowish, and very thin; while that of the female is much larger, of a gray color, and firmer texture. The male chrysalis is brownish, and shows rudimentary wings; the female is much larger, and shows no wing sheaths.

The cocoons may be found in crevices of the bark on the trunk, and large limbs, or in sheltered spots near where the caterpillars have been feeding. In Toronto the trunks of the trees were in some cases almost covered with them, and very many could be found beneath the window sills and the top boards of fences.

In about a week the *imago* appears. The male moth (fig. 54) is winged, and measures about 1¼ inches across the expanded wings; has feathery antennæ and very hairy front legs. The general color is ash-grey; the front wings are crossed by heavy bands of darker shade, with two black markings on the outer edge, near the tip, and a white spot on the inner edge, also near the tip. The writer succeeded in getting very few of the males, but numerous females.

The female (fig. 51) is wingless, of a pale gray color; short antennæ, not feathered. She is scarcely able to walk. Soon after emerging from the cocoon she begins to lay her eggs upon the old cocoon, and covers them with a frothy substance; as soon as this is done her life work ends, she drops exhausted and dies. The winter is usually spent in the egg stage, when clusters of them may be seen upon the trees.

Much depends on the season whether there will be one or two broods (a brood occupies about two months in completing its development).

Natural remedies.—Very few birds care to swallow this hairy caterpillar; the only ones that seem to feed upon it are the robin, Baltimore oriole, and the yellow-billed cuckoo. Some bugs (*Prionidus cristatus*) occasionally attack it. A large number of parasites follow in its trail, and do good work in checking its increase.

A great many ichneumons (*Pimpla inquisitor*) developed among the cocoons brought from Toronto for further examination.

Two Tachina flies also were developed in the cages. They resembled those of the army worm, but were smaller,

Artificial remedies.—1. Spraying with Paris green mixture (1 lb in 150-200 gallons of water) will destroy the caterpillars feeding upon the leaves. If there is any danger of injuring the foliage, 1 lb. to 160 gallons of water, to which is added 1 lb. of quicklime, may be used.

2. Gather the eggs in winter, as they are very conspicuous at that time, and may be readily destroyed.

3. Bands of adhesive material may be painted around the trunk. These will prevent the caterpillars ascending the tree.

This caterpillar, though capable of doing much injury, is not considered to be a difficult one to control. Spraying as above is very effective, and this followed by collecting and destroying egg masses when the leaves have fallen, cannot fail to be successful.

In the case of the attack at Toronto, active measures were not adopted until the caterpillars had almost completed development, and were about to enter the pupa condition.

Energetic efforts were then put forth to destroy the innumerable cocoons that were soon visible. No doubt thousands of egg masses were destroyed upon the trunks of the trees, in the work of rubbing the bark with a coarse brush. At first a band of adhesive material was painted upon the trunks, and thus many caterpillars were prevented reascending the tree, but as soon as cocoons were discovered, this method was abandoned and that of destroying the cocoons followed. It will be well for those interested to be on the watch the coming season, and if caterpillars appear, at once resort to spraying. During the winter all egg masses should be destroyed as far as possible.

Dr. Bethune thought that the Society should be congratulated upon being favoured with so valuable a paper as that to which they had just listened. There could hardly have been presented a more complete life-history of these two species of injurious insects and he was sure that its publication in the Annual Report would prove most useful to a large number of readers. He then proceeded to give his experience of the army-worm this year. (See his paper, Notes on Insects of the year 1896, page 55). At the recent meeting of the American Association of Economic Entomologists held in Buffalo, N. Y., in August last, at which he and Dr. Fletcher had the honor of representing the Society, the army worm formed one of the most conspicuous features among the reports on the season given by many of the members present. Dr. Lintner, State Entomologist of New York, reported its occurrence in forty-eight out of the sixty counties in the state, and considered it the worst insect attack in his experience. Mr. Kirkland stated that it had been very abundant and destructive in Massachussetts, especially to cranberry plants; he estimated the damage done in that state alone at $250,000 at least. In New Jersey, Prof. J. B. Smith had found it numerous in isolated fields, but did not consider that very much damage had been done. Mr. Johnson reported that it was very destructive in Illinois, but its numbers were materially reduced in June, by a fungous or bacterial disease which spread rapidly among them. Prof. Duggar had observed the same thing in Minnesota and considered that the disease was similar to the febrine of silk-worms. Prof. Webster considered that the chinch-bug was the worst insect of the year in Ohio, but the army-worm came second, and was very abundant and destructive. From all this testimony it was evident that the army-worm was wide spread throughout the states adjacent to Ontario; he did not, however, think that we need dread a very serious outbreak next year, as experience taught us that natural enemies so reduced their numbers as to make their ravages insignificant in the year following one of great abundance, nevertheless it would be well to instruct the farmers that their ground should be well cleaned up, and plowed up as far as possible in the fall in order to destroy the hibernating insects.

The Rev. T. W. Fyles regarded Prof. Panton's paper as a very valuable one to the community, and was personally grateful for the information it contained. He came from England to Canada in 1861, which was an army-worm year, and while visiting a friend at Côte des Neiges took a walk into the country. On his way he noticed a high wall around the college grounds on which was a broad black stripe of tar about three feet from the ground. This struck him as very remarkable, and on asking passers by what it was for, he could get no information. Subsequently he learnt that it was intended as a barrier to keep out the army-worm, and no doubt it proved a very effective check. He thought that a roller might be used with great advantage when the worms were crossing a hard surface, such as a road or lane. The tussock moth he had not found in Quebec until three years ago, when it became very abundant and the willow-trees were covered with the caterpillars. Another closely allied species, *Orgyia nova* had always been common in that province.

Mr. Dearness, the President, discussed the question of the migration of the army-worm from marshy lands in dry seasons and mentioned some instances in confirmation of this view.

Mr. H. H. Lyman then read a paper on "The preparatory stages of *Erebia epipsodea*, Butler." (See *Canadian Entomologist*, volume xxviii, November, 1896, pages 274-278.)

Mr. Lyman also presented a paper on some remarkable aberrations in *Colias philodice* and *Vanessa antiopa*, and exhibited the singular specimens referred to. Those of the former species were taken by Mr. Dwight Brainerd, of Montreal, at Edgartown, Mass., in August last. (See *Canadian Entomologist*, volume xxviii, December, 1896, pages 305-6.); the suffused black specimen of *V. antiopa* was captured in British Columbia.

ELECTION OF OFFICERS.

The following gentlemen were elected officers for the ensuing year: (See page 2.)

AFTERNOON SESSION.

The meeting was called to order by the President, Mr. J. W. Dearness, at 2.30 o'clock p.m. The following paper was then read by Dr. Bethune:

NOTES ON INSECTS OF THE YEAR 1896.

BY REV. C. J. S. BETHUNE, PORT HOPE.

THE ARMY WORM.

The season of 1896 is chiefly remarkable, from an entomological point of view, for the outbreak of the army-worm in this Province of Ontario. The insect, in its winged state at any rate, has long been familiar to every collector and is every year more or less abundant. We have all read accounts from time to time of its ravages in various parts of the United States, but hitherto we have been free from any serious invasions in this country. As this year's outbreak is being fully discussed by others, I shall merely mention what has come under my own observation.

On the 17th of July I received the following note from the Rev. Stearne Tighe of Emerald, Amherst Island: "I send you to-day by mail, specimens of a grub that is destroying all grain, etc, on this Island. What is it? Is there any way of destroying it, or arresting its ravages? This Island contains 15,000 square acres, and is at its nearest point two miles from the mainland." I at once recognized the specimens to be the notorious "army-worm" (*Leucania unipunctata*), which had already been reported in the newspapers as having appeared in injurious numbers in various parts of the province. I immediately wrote to Mr. Tighe and informed him of the usual remedies, namely, plowing a deep furrow to stop the onward march of the "army," if it were moving on from field to field, and destroying the caterpillars thus collected by burning with straw spread along the furrow or dragging a log of wood through it; or, if the worms were congregated in a field of grain, treating them with Paris green in order to prevent their going further. The specimens sent to me proved to be badly infested with maggots, the larvæ of a Tachina fly, and only one in consequence succeeded in reaching the chrysalis state, the rest being destroyed by their parasites. If the same proportion of worms were attacked in the fields of Amherst Island, there is not much danger of a repetition of the outbreak next year.

A few days later in the month, specimens of the same "army-worm" were brought to me from a field of grain adjoining my own garden at Port Hope. They were then fully grown and had done a great deal of damage by gnawing the soft grain in the wheat-ears. The farmer, whose crop was thus injured, informed me that the worms had crossed the road in the form of an "army" on a Sunday afternoon (where they had come from no one had observed) and at once proceeded to scatter over the wheat field and climb up the stalks to the ears. Fortunately the grain was rapidly ripening and soon became too hard for the jaws of the caterpillar and the loss was not so serious as might have been anticipated.

About the first of August the moths began to appear and for a couple of weeks they swarmed in countless myraids. Some Tartarean honey-suckle bushes in my garden were laden with ripened berries; these attracted the moths to such an extent that the twigs were covered with them towards evening and during the night. On being disturbed by shaking the bushes, they would fly out in clouds. The moth has always been familiar to us, and is often taken by collectors when "sugaring" in the summer, but I never before saw it in such abundance.

On writing to Mr. Tighe about this time, recommending the destruction of the moths, which could be attracted by sugar or light, and enclosing specimens in order that there might be no difficulty in identifying them, he replied that the worms had disappeared shortly after his previous communication and no further damage had been done by them. They had, of course, completed their larval period and had gone into the ground to transform into chrysalids, large numbers of them then dying from the internal ravages of parasites.

In addition to the good work of the Tachina flies, which resemble the ordinary housefly and appeared in swarms over infested fields, the worms were attacked by several species of predaceous insects, and were also devoured in large numbers by the English sparrow, which in some localities visited the army-worm districts in great flocks.

THE TUSSOCK-WORM.

Another insect which attracted much attention this summer and brought out many articles and letters in the newspapers, was the Tussock-worm (*Orgyia leucostigma*), which defoliated many shade trees in the streets of Toronto. As it has been fully dealt with already by Prof. Panton in his valuable and interesting address, I need not go over the same ground again. During my occasional visits to Toronto, I have noticed this insect for several years past and have drawn the attention of friends to its injurious work on their shade trees. It ought not to be a difficult insect to control as it cannot spread with any great rapidity owing to the fact that the female is wingless and can only crawl a short distance. The cocoons are usually so conspicuous in the autumn after the leaves have fallen and during the winter, that boys could be employed to scrape them off and destroy them. A tree once cleared will remain for a long time free from any further attack. In Port Hope the insect is common enough, but has never been so abundant as to cause any appreciable injury.

THE BLACK POTATO BEETLE.

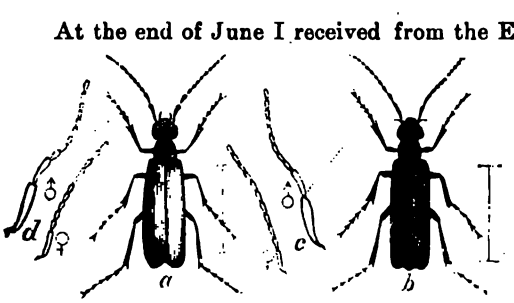


Fig. 56.

At the end of June I received from the Editor of the *Mattawa Tribune*, some specimens of a beetle that was attacking the potato plant in myriads in the neighborhood of Mattawa, Ont. They proved to be the black blistering beetle (*Macrobasis unicolor*, Kirby), a species that belongs to to the same family, Meloidæ, as the "Spanish-flies," which are used for blistering purposes by the medical profession, and that possesses the same vesicating properties. The insect (Fig. 56) is long and slender, about half an inch in length, lack in colour and covered with fine whitish hairs which give it an ashen appearance; these hairs are easily rubbed off and leave the insect quite black. It is a northern species and is much more commonly found in the upper Ottawa region and on Manitoulin Island than in Southern Ontario. In the neighborhood of Montreal it has been very abundant on Windsor, or English broad beans, and caused much damage to these plants in some gardens. While at times very destructive to these plants and to potatoes, it is unlike most injurious insects in possessing one good habit at least, and that is its practice of feeding upon the larvæ of the Colorado potato beetle. The question may therefore arise as to whether it does more good than harm. If the evidence should be adverse, then it may be dealt with precisely as its prey, and the "two birds be killed with one stone" by an aplication of Paris green in the usual manner. As far as I know, the black blistering beetle has only one brood in the year, and therefore only attacks the food-plant for a limited period, whereas the Colorado beetle has a succession of broods throughout the season, and never ceases its depredations from the time when the plants first appear above the soil in spring, till they are ready to be dug in the autumn.

MISCELLANEOUS.

For some ten years or so the apple-tree tent-caterpillar (*Clisiocampa Americana*, Harris) (Fig. 57) has not been seen in the neighborhood of Port Hope, but this year it has put in an appearance again and I have observed a few of the moths. In Peterborough and about Toronto it has been quite numerous and destructive. Formerly it was one of the worst pests of the fruit grower that we had, and its webs were to be seen in spring and early summer on apple, pear, plum and cherry trees, and especially upon the wild varieties of the two latter. One spring, however, they were practically exterminated. The tiny caterpillars emerged from the eggs, which are laid in "bracelets" (Fig. 57, *c*) around twigs of the affected tree, at the same time as the leaf buds first opened and at once began to devour them A few days later there came a severe frost which was too much for the tender little worms and they were all killed, giving us an immunity from the pest for a number of years. Now that they have begun to appear again, it will be well for fruit growers to be on the look out next spring and to destroy every "tent" with its inmates as soon as it is discovered.

Grasshoppers, which were very numerous and did a great deal of damage to pastures, and hay and oat crops, during the two preceding years, were this season remarkably few in numbers and caused no appreciable injury.

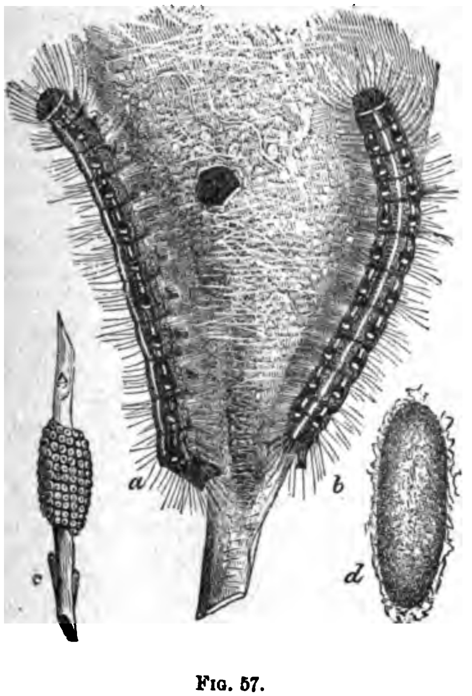


FIG. 57.

Various species of plant-lice (*Aphis*) were excessively abundant and injurious to plants of all kinds during the summer; the long continued hot and dry weather being very favorable to their increase. Even such weeds as the Lamb's-quarter were covered with them and many cultivated flowers in gardens suffered severely.

The Cigar case bearer (*Coleophora Fletcherella*) was found in June upon some neglected apple trees on the edge of a field near Port Hope. This pest which has been a serious one in some localities during the last few years, is evidently spreading in Ontario and should be carefully looked for in spring and early summer. A full account of the insect and the best modes of dealing with it is given in the report for 1895 of Dr. James Fletcher, the Dominion Entomologist and Botanist.

The Fall Web-Worm (*Hyphantria textor*). (Fig. 8) which has been for many years excessively abundant on ash, elm and many fruit trees, has this year been quite scarce about Port Hope, but in the neighborhood of London,—as our president Mr. Dearness relates—it has been conspicuously prevalent and many tree have been covered with immense webs. How to account for these remarkable changes in the numbers of injurious insects from scarcity or abundance in one year to the reverse in the next is one of those puzzles which may well employ the attention of the thoughtful entomologist. Sudden changes of temperature as we have seen in the case of the apple-tree tent caterpillar, very hot and very dry weather, an unusally wet and cold season, violent storms, all these no doubt have great influence in reducing the numbers or favoring the increase of some species of insects, and in addition,—perhaps most of all—the increase of the parasites that prey upon the noxious species, and the spread of infectious diseases are great factors in the problem. It can only be solved by patient daily observations of a particular species carried on from year to year by more than one investigator. This is a field of work open to all and one that may result in the acquisition of a knowledge that will be of very great scientific and practical value.

Dr. Bethune also referred to the large number of rare butterflies that had been captured this year and gave a list of their names, with localities and dates. He then read a paper by Prof. Webster, of Wooster, Ohio, who was unable to be present, on "Warning colors, protective mimicry and protective coloration."

It was then moved by W. E. Saunders, and seconded by J. A. Balkwill, that "The Entomological Society now in Session at its annual meeting, having learnt of the sympathetic statement of its work and aims made by the Hon. John Dryden, Minister of Agriculture, at the time when the grant to the Society was under the consideration of the Committee of the Ontario Legislature, desires the Secretary to convey to the Honorable Minister its sincere appreciation of his kind interest."—*Carried.*

Moved by J. A. Balkwill, seconded by W. E. Saunders, that the Secretary be requested to communicate with the Board of the Western Fair Association, requesting them to continue to offer encouragement to the Schools to make exhibits of the life-history of insects, and that their influence be used on the Fair Boards to encourage similar exhibits.—*Carried.*

Moved by D. Arnott, seconded by W. E. Saunders, that Messrs. Rennie, Balkwill and the President, be appointed a committee to meet the Board of the Young Men's Christian Association, and endeavor to make satisfactory arrangements with regard to the renting of a room for the Society, and the approaches thereto.—*Carried.*

The meeting then adjourned, after having spent much enjoyable time during the sessions on both days in exhibiting rare captures, examining the books and specimens of the Society, and comparing notes on many interesting entomological subjects.

. INSECT INJURIES TO ONTARIO CROPS IN 1896.

BY JAMES FLETCHER, DOMINION ENTOMOLOGIST, OTTAWA.

There is never a season when serious loss does not occur in some part of Canada from the attacks of our numerous insect enemies. There is, however, during a succession of years great fluctuation in the amount of insect presence in any one locality. New pests develop or old ones reappear after a period of absence, and then again sometimes suddenly disappear. Day by day additions are being made to the mass of accumulated knowledge by the use of which the injuries of insects can be prevented. The importance of the study of Practical or Economic Entomology is now widely recognized by all the civilized nations of the world. This confidence in a branch of science not taken up by many investigators is undoubtedly due to the fact that those concerned have found by experience that they are able to receive useful advice from those who have made a special study of the lives of insects, by which they are enabled to save a larger proportion of their crops than would otherwise be the case, and thus increase their incomes.

It requires many years of close study and constant observation before one can become familar with all the different attacks by insects which may demand the attention of a farmer or gardener even in a single season; but the general principles upon which remedies are applied can soon be learnt, so as to prevent foolish mistakes. A fact which must never be forgotten is that all insects have their mouth parts formed after one or other of two plans only. In one class, solid food is eaten by means of jaws, with which it is bitten off from the object attacked; in the other class, liquid food, such as the sap of plants or the blood of animals, is sucked by means of a hollow tube-like beak. It is most necessary to remember these elementary facts, because in accordance with them all active remedies are devised. For biting insects, some poisonous material is placed on their food, so that when this food is eaten by the insects they may be destroyed. For sucking insects, this method would be useless, because, having no jaws, they can feed only on liquids, for which they have to sink their sharp beak-like feeding tubes beneath the surface of the object attacked. For this class of insects, substances which will kill by simply coming in contact with their bodies must be used.

Farm crops in Ontario during the past year have not suffered from any new pests, but there has been as usual considerable loss, which might have been prevented, had the attacks been promptly reported and the proper remedial measures adopted. The three most striking infestations of the season were grasshoppers, army-worm and a local outbreak or rather increased abundance of the Tussock moth in Toronto. Under the headings of the different classes of crops, attention is called here to those which have been most frequently complained of.

Cereals. The wheat crop of the Province has been little affected by insects, and although different kinds have been mentioned by several correspondents, there has been no serious outbreak. The Wheat-stem Maggot (*Meromyza Americana*, Fitch), was conspicuously less abundant and the American frit-fly (*Oscinis variabilis*, Loew.) was not only not mentioned, but it was impossible to obtain a single specimen for examination even in localities which were badly infested in 1890

Grasshoppers were stated to be the cause of some injury to wheat, but the crops most injured by these insects were oats and hay. It is well to make special mention of the Hessian fly (*Cecidomyia destructor*, Say), fig. 58, which has been present in several places, and farmers must be prepared next year, if its injuries increase, to adopt the well known remedies of sowing their fall wheat later (about the third week in September) and burning carefully all screenings and dust from threshing machines. The Wheat Midge (*Diplosis tritici*, Kirby), fig. 59, which has been heard little of for the past six or seven years, again put in an appearance in one or two localities. This, also, will be largely controlled by the systematic burning of the rubbish from threshing machines.

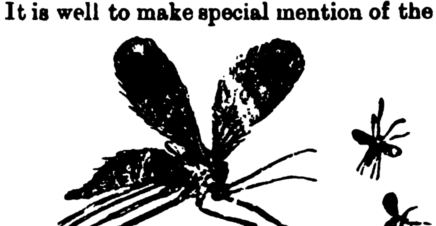


Fig. 58.

Oats have, perhaps, suffered from insects more than any other of the small grains The Grain Aphis (*Siphonophora avenæ*, Fab.) was unusually abundant in some places. Oats were also among the crops mentioned by several who wrote concerning the army-worm (*Leucania unipuncta*, Haw.) One of the most notable outbreaks of the year 1896 was by the caterpillars of this insect. There was hardly a county in the Province where it was not reported either as a caterpilar attacking crops or as a moth which had drawn attention by its excessive numbers. This pest has been treated at length by Prof. Panton in the present report, so need not be mentioned further here, except to draw the attention of those interested to the excellent bulletin lately issued by Prof. Clarence M. Weed of the New Hampshire Agricultural Experiment Station. It is interesting to learn from this bulletin that in 1770 in the celebrated occurrence of the army worm in New Hampshire, the same remedies which we most rely on to-day, namely, trenching around fields infested and destroying the caterpillars in pits dug at intervals in the trenches were practised by the farmers of that State. As is almost invariably the case, the superabundance of the army-worm this year was much reduced by the natural enemies which always prey upon this species.

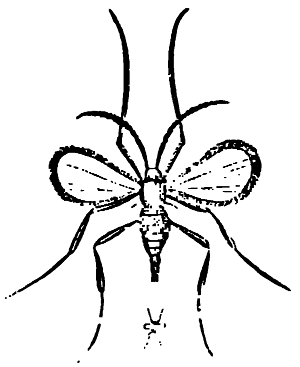


Fig. 59.

At the late meeting of the Association of Economic Entomologists held at Buffalo, N.Y., Dr. J. B. Smith stated that the army-worm had appeared in New Jersey in some numbers, but only in isolated localities. In Canada, in almost every instance where invasions of this insect have been recorded, the injury has been done by a brood which appears in the larval form during the month of July and in the beginning of August; but Dr. Smith stated that it was not always the same brood which did the damage in New Jersey The first brood seemed to be the injurious one in a southern county of the State, reports having been received as early as May. At other localities in the State injury was noted in July and as late as early in August. This is practically the same as is the case in some of our northern counties of Ontario The most interesting record, however, is given by Mr. A. H. Kirkland, of the Massachusetts Gypsy Moth Commission, who stated that "the army-worm had been seriously injurious in many parts of Massachusetts and had damaged a large portion of the cranberry crop. He writes Sept. 3 that at Hingham, Mass., a third brood of army-worms was then threatening to be as destructive as any that preceded it. He found them at that time of all stages from quite young to nearly mature." (*Entomological News*, *VII*, 1896, p. 310.)

Fodder crops. Early in the season grasshoppers of the three common species, the Red-legged locust, fig. 60, the Two-striped locust, and the Lesser Migratory locust, were noticed to be remarkably abundant throughout Ontario and Quebec and in parts of Nova Scotia. These species are always somewhat prevalent, but great anxiety was felt in June last when their ravages were seen in pastures and hay fields. Clover was badly eaten in some districts early in the month and also wheat, oats and barley. Later in the summer corn, beans, turnips, and even hops were attacked. There was every appearance in July that the losses would even exceed those of 1895, but early in August it was clear that for some reason the grasshoppers were much less numerous than they had been. Several correspondents made the same report, and a few of them observed that parasites were waging an effective warfare against the locust tribes. Doubtless the sudden disappearance of these pests was due to the great increase of four of their natural enemies. One of these is a fungous disease (*Empusa grylli* [Fresenius] Nowakowski), which causes its victims to crawl up to the tops of stalks of grasses and other plants, where, grasping the stem firmly with their legs they die and their bodies become rapidly filled with a dry, mealy substance, which is really myriads of the spores of the parasitic fungus. The body of the locust soon dries up a the spores are distributed by the wind, each mummified carcass thus becoming a source infection to all other locusts which come near it. In addition to the above fungus thr other parasites—insects—were unusually abundant. One of these was a Tachina fly, fig 6 which was described as following the locusts closely and darting down, laying its whit

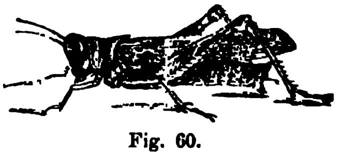


Fig. 60.

eggs on their bodies. From these eggs in a short time hatch white maggots which feed inside the bodies of their hosts until full grown, when they force their way out and, falling to the ground, which they enter a short distance, they pupate, and change to flies either the same autumn or the next spring. Prof. Riley describes graphically the operation of egg-laying by one of these Tachina flies, and much the same thing was observed by Mr. J. E. Richardson of Princeton, Ont., last July. Prof. Riley says: "The slow-flying locusts are attacked while flying, and it is quite amusing* to watch the frantic efforts which one of them haunted by a Tachina fly, will make to evade its enemy. The fly buzzes around waiting her opportunity, and, when the locust jumps or flies, darts at it and attempts to attach her egg under the wing or on the neck. The attempt frequently fails, but she perseveres until she usually accomplishes her object. With those locusts which fly readily, she has even greater difficulty; but, though the locust tacks suddenly in all directions in its efforts to avoid her, she circles close around it and generally succeeds in accomplishing her purpose, either while the locust is yet on the wing, or, more often, just as it alights from a flight or a hop." Locusts infested with these parasites are more languid than they otherwise would be; yet they seldom die until their unwelcome guests leave them of their own accord.

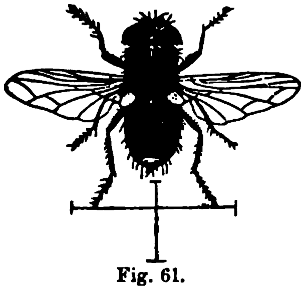


Fig. 61.

Probably the most efficient worker in keeping down the undue increase of grasshoppers is the Locust Mite (*Trombidium locustarum*, Riley), and it has been extremely prevalent and very often observed during the past summer. As it is seen attached to grasshoppers, generally at the base of the wings, it bears little resemblance to an insect and few recognize it as such the first time they examine it. The bright red swollen bag-like bodies are really the larval form of the Locust Mite, and are possessed of six weak legs, as may be discovered by examining them closely. (See figs. 62 and 63, opp. page 64). The mouth parts are very poorly developed, and, when once the mites have attached themselves to their host by means of their beak-like mouths, they remain unmoved, living on its blood until full grown. By these little parasites vast numbers of locusts are destroyed. When ready to assume the pupal condition, they detach themselves, and, falling to the ground, crawl under some shelter to complete their transformations. Gradually swelling and changing their form slightly, the mites pass through the pupal stage inside the larval skin; new legs, mouths and other organs, of a different nature to those possessed by the larvæ, are formed under the old skin, and finally this latter bursts and releases a creature very different from and much more active than the larval form. It has now eight legs and is a true *Trombidium*. The perfect mites are very conspicuous and draw attention by their velvety, bright scarlet bodies; they are frequently spoken of as "Scarlet Spiders" when sent in for identification. In this stage they are equally useful allies to the farmer as in the larval form, for while they do not attack the full grown locusts, they seek out their eggs in the ground and destroy large numbers of them. They pass the winter in the mature form and are frequently seen crawling over the ground in spring.

In May the female lays a mass of between 300 and 400 small, round, orange eggs in a cavity an inch or two beneath the surface of the ground. The young, as stated above, have six legs only and are at first exceedingly minute but very active. They crawl about until they find a locust, to which they attach themselves, mostly at the base or along the principal veins of the wings. Here they swell by degrees until their legs become almost invisible, and this is the time they are most often noticed. There has been considerable confusion as to what is the proper name of this mite. In the first place, it was not known, until Prof Riley in 1877 worked out the life history of this species, that the bag-like bodies with six legs only, which were so often found attached to locusts, and which were classified under an entirely different genus, *Atoma* (= *Astoma*) of Latreille, were merely the immature condition of the little red mites with eight legs which were found devouring the eggs of locusts in the ground, and when this fact was discovered there was still room for confusion as to whether it should be called by the specific name first given to the larva when named *Atoma gryllaria* by Dr. Le Baron in 1872, or by the name of the perfect insect described in full by Dr. Riley after its true nature had been found out.

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* The locust might well say here, "It's fun for you but death to me."

In Murray's *Aptera*, without date but bound up with Official British Museum Advertisements dated October, 1876, and presumably issued in that year, this mite is treated of under the head of *Trombidium gryllarium*; but, in Mr. Samuel Henshaw's Bibliography of American Economic Entomology, 1890,—a most valuable and carefully prepared work, which will probably be accepted as authoritative by all Economic Entomologists—*Astoma gryllarium* is made to equal *Trombidium locustarum*, and it is, therefore, well for us to adopt the latter name and to drop altogether the name *Atoma* or *Astoma gryllarium*, referring to the stage found attached to locusts merely as the larval stage of *Trombidium locustarum*, Riley.

Besides those mentioned there are many other different kinds of parasites which infest locusts, but none perhaps which excite more surprise when their strange habits are explained than the curious creatures known as "hair snakes" or "hair worms," with their slender hair-like bodies from six to twelve inches in length tapering to each end and only at most one twenty-fifth of an inch through at their greatest diameter. These may be seen sometimes crawling on or coming out of the ground in large numbers after a shower of rain, sometimes along the edges of streams, either coiled and knotted up one or many together, or singly swimming close to the surface of the water with an undulating snake like motion. Dr. Leidy, in his very valuable article on *Gordius* which appeared in the American Entomologist for 1870, when referring to the habit of these worms of coiling themselves in intricate masses, suggests that "similar knots no doubt were the source of the scientific name of the worm being applied to it by Linnæus from the fabled Gordian knot of antiquity. The *Gordius*, however, not only resembles the latter in the intricate condition into which it sometimes gets, but its history is yet in part a Gordian knot to be unravelled.'

These worms are not, by any means, unfamiliar objects in the country, and various misconceptions as to their sudden appearance in large numbers and as to their origin are widely prevalent. They are frequently sent for identification with the statement that they had fallen from the clouds in rain. The commonest error, however, is that they are horse hairs which, having fallen into water, have "come to life." It is not necessary here, of course, to point out the absurdity of this statement. "Such a transformation is an utter impossibility. No dead organic matter can thus be changed into a living creature. It is a law of nature that every animal being, from the lowest to the highest, has its commencement in an egg." (Lintner).

Several articles more or less complete have appeared on these worms. By far the fullest is the extended account in the First Report of the United States Entomological Commission, 1878, where probably nearly all that is at present known of their mysterious life history is collected together, and good illustrations are given. The hair worms,—of which there are several species, found parasitic in the bodies of insects of nearly all the different orders, such as the Orthoptera, Hymenoptera, Coleoptera, Lepidoptera and Diptera,—belong to the Entozoa or intestinal worms. They have a very remarkable cycle of development, which may be briefly summed up as follows: The eggs are laid in water, and the exceedingly minute young worms float about in a free state until they find the larvæ of some aquatic insects into the bodies of which they effect an entrance, as was observed by Dr. Meissner, a German scientist, through the delicate membrane at the joints of the legs. They then work their way gradually among the muscles and other organs throughout the body of their host and after a time become quiescent and encysted so as to resemble their former condition just before leaving the egg, and, as Dr. Meissner says, recall to mind the similarly encysted Trichinæ in the muscles of man and the hog. Mr. A. Villot added materially to our knowledge of these curious creatures and found that, when insects infested with these encysted larvæ were eaten by fish, the bladder-like cysts were dissolved by the process of digestion and the young worms set free in the intestines of their new host, at once bored by means of spines around the head into the mucous layer of the intestines of the fish, where they became again encysted. In the next stage, which is not reached till spring. five or six months afterwards, they live a free-swimming aquatic life. To obtain their liberty, they first free themselves from their cysts in the lining of the intestines and pass into the intestinal cavity of the fish, whence they are carried out with the fæces into the water. Here remarkable changes take place. Mr. Villot says: "The numerous transverse folds of the body disappear and the worm becomes twice as long as before; its head armature disappears; the body becomes swollen, milky and pulpy. It remains immovable in the water for a variable period and then increases in size. The integument grows harder and when about two inches long the worm turns brown and begins to move."

At this point in the life history of these creatures all actual observation ceases, and it is only a matter of conjecture how these parasites can find their way into the bodies of such insects as locusts, tree crickets and beetles, many of which live preferably in dry places. It has been suggested that the worms can travel long distances on foliage and other surfaces when wet with rain or dew. It must be acknowledged that there is room for much careful investigation as to the habits of these useful allies of the farmer. What is well known, however, is that they are certainly parasites which occur frequently inside the bodies of many of our injurious locusts, and during the past season were so abundant in some places—as at Ottawa—that they could be found in varying numbers from one to five, generally two or three, in almost every large-bodied locust that was examined during the months of September and October.

With the dark-colored *Gordius* worms are usually found inside the same hosts some smaller and slenderer white specimens which are very similar in general appearance; they belong to another genus (*Mermis*) differing in many respects as to structure and some stages in their life histories, but equally useful with them from their habit of living as parasites inside and ultimately destroying locusts and grasshoppers as well as other insects.

In connection with grasshoppers mention must be made of the rather serious ravages of the Gray Blister beetles (*Macrobasis unicolor*, Kirby). fig. 56. These have been abundant in some localities during the past season and have infested fields of potatoes and beans; they were also troublesome on the Siberian Pea tree (*Caragana*), now grown considerably for hedges, also on the large-leaved and ornamental Aralias, *A. spinosa* and *A Chinensis*. In the larval form these beetles are parasites in the egg pods of locusts, so that an abundant occurrence of blister beetles indicates that the armies of destructive grasshoppers are much smaller than they would have been but for this good feature in the habits of these otherwise injurious insects. The blister beetles generally appear suddenly and in large numbers, and if they are not attended to at once they quickly do much harm to a crop. Prompt spraying or dusting with Paris green are effective and where practicable great numbers may be beaten into pans containing water and coal oil. A long piece of Caragana hedge was saved in this way by giving it two beatings a day for a week in a locality where Paris green could not be obtained.

There have been other injuries to fodder crops: The Clover Root-borer (*Hylesinus trifolii*, Miller) occurred at one locality in the County of York, and the Clover-seed Midge (*Cecidomyia leguminicola*, Lintner) was rather more destructive than usual in the clover seed growing districts. Even in the eastern part of the Province its presence was clearly discernable by the appearance of the fields at the time of blooming. Reports vary as to the prevalence of the pea weevil, but, on the whole, while it seems to have been less injurious in the west, specimens have been found this year in pease grown as far east as Ottawa, which is a very rare occurrence.

Root Crops.—The rootcrops have been affected somewhat both by weather and insects. There has been mention of white grubs (*Lachnosterna*) Fig. 64, in potato and carrot fields, and, as mentioned above, grasshoppers and blister beetles have done their share of injury. The outbreak of most interest under this head was of the Clover Out-worm (*Mamestra trifolii*, Esp.), which appeared during August in large numbers in the district lying around Rice Lake. The crops attacked were turnips, mangels and peas. The loss was greatest in pea fields, the leaves and even the fleshy tissues on the outside of the pods being entirely consumed. The caterpillars which vary very much in color and ornamentation first appeared about the first of August, and were in such numbers that they had to migrate to obtain food, and for this reason were thought by some to be the army worm One correspondent wrote, "The green leaves and the vines themselves were eaten, but my peas were too nearly ripe before they were attacked to be much injured. I never before saw anything like it. The ground was literally alive with the crawling insects. We put Paris green on the turnips, and this doubtless helped, but the insects were so numerous that one set after another took the place of those killed. Turnips near peas were injured most; they put forth a new set of leaves, but the growth of the roots was stunted, and they were only half a crop."

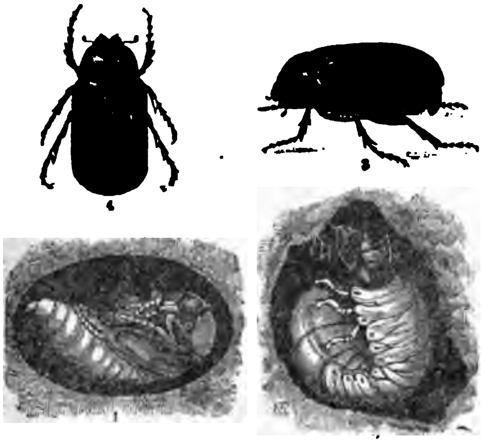


FIG. 64.

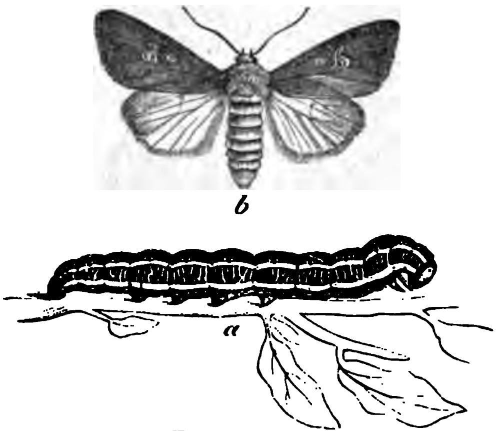


FIG. 65.

Turnips were also slightly injured by the Zebra caterpillar (*Mamestra picta*, Harris) which is a very general feeder, being found also on cabbages, potatoes, clover, celery, lucerne and many other plants. The caterpillar is a most showy insect (Fig. 65*a*); when full grown nearly two inches in length, velvety black on the back with the sides gaily ornamented with golden yellow lines connected by wavy white threads; the head and feet are chestnut red. When ready to transform the caterpillar spins a loose cocoon of silk with earth mixed with it and changes to a black chrysalis. The moth (Fig. 65*b*) has glossy brown upper wings and the lower ones are whitish. The eggs are laid in large clusters beneath leaves and seem to be, at Ottawa at any rate, much more infested with egg parasites than those of almost any other insect. In September, 1892, I found upon a plot of Bokhara clover (*Melilotus alba*, Lam.) hundreds of clusters of the eggs of this moth, which were so much parasitised by two minute hymenopterous insects, *Trichogramma pretiosa*, (Fig. 66), and a new species of *Telonomnus*, that not one per cent. of the eggs gave caterpillars. The only remedies which can be applied for the Zebra caterpillar are arsenical mixtures, and this species seems to be particularly resistent to the effects of all poisons so far experimented with. There are two broods in the year, the latter of which may be noticed on fine days long after the first severe frosts.

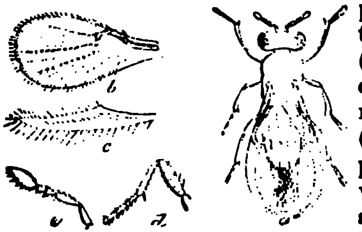


Fig. 66.

VEGETABLES.—In gardens the regular yearly pests such as cut worms, turnip flea, Colorado potato beetle, and the cabbage caterpillars have required attention. The species of cut-worm whose injuries have been most conspicuous, has again this year been the red-back cut-worm (*Carneades ochrogaster*, Gn.) This is a large and widely distributed species which feeds upon almost every kind of succulent vegetation. It was particularly destructive to newly set cabbages and tomatoes and to young beet root, as well as many annuals in the flower garden. Careful trial was made this year of the poisoned bran remedy, and good results were obtained. Bran or oat-meal was moistened with sugar in water sufficiently to allow of being ladled out with a spoon. Into this sufficient Paris green was

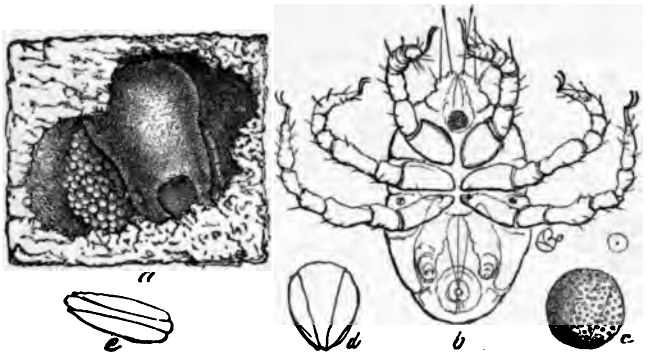


Fig. 62.—Trombidium locustarum.—*a*, female with her batch of eggs; *b*, newly hatched larva—natural size indicated by the dot within the circle on the right; *c*, egg; *d*, *e*, vacated egg-shells (after Riley).

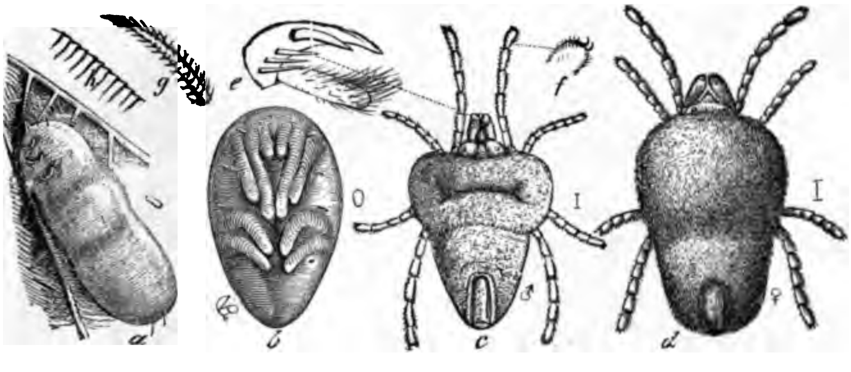
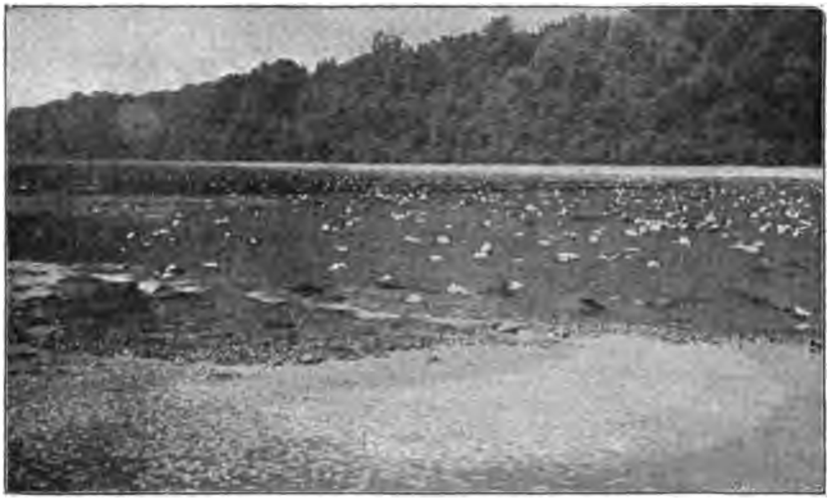
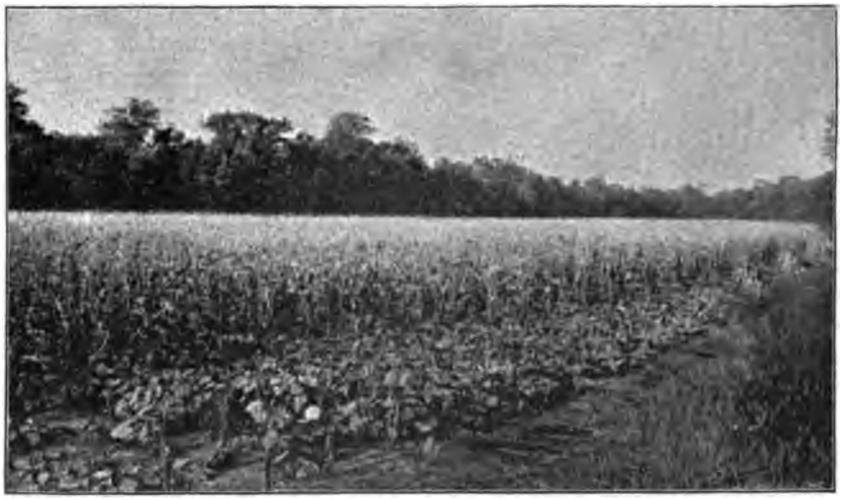


Fig. 63.--Trombidium locustarum.—*a*, mature larva when about to leave the wing of a locust; *b*, pupa; *c*, male adult when just from the pupa; *d*, female—the natural sizes indicated to the right; *e*, palpal claw and thumb; *f*, pedal claws; *g*, one of the barbed hairs; *h*, the striations on the larval skin (after Riley).

(*See page 61.*)



Phelps Lake in Illinois, August, 1894. Dead Fish and Mussels. (After Forbes.)



Phelps Lake, August, 1895. After being brought under cultivation. Corn and Pumpkins. (After Forbes.)

(See page 84.)

stirred to give it a decidedly green tinge. A spoonful of this mixture was placed at intervals of six or eight feet along rows of peas, beets and carrots, which were being rapidly destroyed by these cut-worms. The results were most satisfactory, the poisoned bran was apparently so attractive to the caterpiliars that only two or three plants were afterwards cut off and the bran was eaten instead, many caterpillars being found dead near the bran but some distance under the surface of the soil, where they required to be looked for with some care.

The "Black Army-worm" (*Noctua fennica*, Tausch) was abundant in the neighborhood of Picton, Ont., where it did much harm to peas and other garden plants, including raspberries and other small fruit.

Squashes and cucumbers have been much injured in western Ontario by the striped cucumber beetle (*Diabrotica vittata*, Fab.), and the true squash bug (*Anasa tristis*, De Geer) Fig. 67, was reported as very troublesome at Hamilton. When the plants are young and small, probably the best remedy is to cover the hills with a square of mosquito netting, or cheese cloth, supported by two or three sticks stuck in the ground and with the edges held down with a few handfuls of earth. When the plants get too large to be so confined, the insects may be kept away to a measure by sprinkling over the hills ashes or land plaster with which coal-oil has been mixed. Hand-picking for the Squash Bug must also be resorted to; for this purpose shingles are placed near the plants for the bugs to hide under.

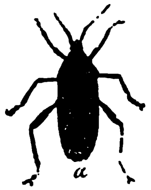


FIG. 67.

FRUITS.—Fruit insects in Ontario have been decidedly less noticed during the past season than for many years previous. This is probably due to the enormous crop which has been reaped; timely rains and fair weather for fruit crops seem to have prevailed over the whole Province. As in the past those who sprayed carefully, obtained paying returns. Although, on the whole, insect enemies have demanded less attention than usual, it is feared that carelessness in orchard management by which defective and infested fruit was left unpicked from the trees or to rot on the ground, may be followed next year by a large increase in the number of injurious insects which will in all probability infest a much smaller crop over the whole Province.

In western Ontario the second brood of the codling moth was particularly destructive. The work of the plum curculio, owing to the enormous crop of plums, was not so manifest as usual, but where looked for, could usually be found, In some districts where plums are not much grown, this is by far the worst enemy of the apple crop. The apple curculio (*Anthonomus quadrigibbus*, Say.) is not a very frequent enemy of the apple in Canada, seeming to confine its attacks more particularly to the fruit of the hawthorn. Two new attacks upon apples of considerable interest to fruit growers have to be recorded. The first of these by the caterpillar of a small moth which has not yet been bred to maturity, has affected to an appreciable degree the apple crop of certain localities in British Columbia, and what may possibly be the same insect has been found in a few instances at Ottawa and Montreal, but the injury to the fruit was much less serious than in the British Columbian apples, where the caterpillars burrowed in every direction through the flesh of the apple, causing it to decay and entirely destroying it for the market. The outside of the fruit was also gnarled with sunken depressions where the caterpillars had entered, and in many instances, this spot was marked with a white deposit similar to birds' droppings. This latter fact, however, is comparatively of small consequence, because the fruit bearing these deposits is already destroyed by the discolored burrows of the caterpillars which run in every direction through the fruit for which reason the name of "apple fruit-miner" is suggested. Judging from the nature of the injury to the apples this season, this is certainly a much more serious enemy than the larva of the codling moth, and the condition of an infested apple is much more nearly like that produced by the apple maggot (*Trypeta pomonella*, Walsh) for which indeed it was mistaken by some observers, but from which it is entirely distinct. The second attack new to this country, is by the true "Apple Maggot" which this year for the first time on record has infested cultivated apples in Canada in the orchard of Dr. D. Young, a careful observer of insect habits, living at Adolphustown, Ont.

At the end of October Dr. Young sent me some apples containing a few larvæ and showing undoubtedly the work of this injurious insect which he had never found in his orchard before this season. Three or four varieties only of apples were infested. It is important to notify fruit growers as soon as possible of the occurrence of this insect in our orchards as an apple pest and to give from the experience of growers in the New England States the measures which have been found most successful in fighting against it. The insect was first described by Walsh in his first report as State Entomologist of Illinois in 1868; but it had been known in the eastern states for several years before that, having attracted attention by its serious injuries to the cultivated apples in New York, Massachusetts, Connecticut and Vermont. Strange to say, although it has never, as far as I can learn, attacked cultivated apples in Canada until this year, it is common in collections of insects and occurs abundantly in the fruit of hawthorn in many localities. In 1887 I bred the fly from haws found at London, Hamilton, Toronto, Montreal and Ottawa. In 1888 the fruit of the hawthorn bushes on the Experimental Farm was so much infested by the maggot of this fly and the grub of the apple curculio that it was almost impossible to find a sound fruit. It is, however, by no means a singular habit for an insect to confine itself to a certain food plant in one locality when others are growing close to it, which elsewhere are preferred by the same species.

The most important articles on this subject have been written by Walsh (Ill. Rep. I.), Comstock (Rep. U. S. Comm. Agric., 1881-2), and particularly Prof. Harvey, who wrote a long and complete account in the annual report of the Maine Agricultural Experiment Station for 1889, where the full life history of the species is for the first time detailed. The life of this insect may be said to be as follows: The perfect flies begin to emerge about the first of July and continue to appear until about the middle of September; eggs are laid at once, those first deposited producing the earliest flies the following season. The egg is forced through the skin of forming apples by means of the horny ovipositor of the females. The maggots hatch and run tunnels all through the fruit of the apple leaving discolored brown tracks wherever they go. In this way the fruit is rendered quite unsaleable and ripens prematurely. The maggots are full grown in about five or six weeks, and as soon as the fruit falls they leave it and entering the ground a short way turn to puparia and in that condition pass the winter. Early and sub acid varieties of apples seem to be preferred, but late and winter varieties are also attacked. When the late varieties are infested, the maggots do not emerge until sometime during the winter after the fruit has been stored. In all Prof. Harvey's investigations he never saw an apple hanging on the tree from which the maggots had emerged. This is an important point because it shows the value of collecting all fallen fruit as soon as possible after it falls and destroying it so that the maggots may not leave and go into the ground to pupate. There are different ways by which this may be done. They may be collected by children and fed to stock, or, if there is no stock to eat them, they may be buried in a deep hole and afterwards covered up so that the flies may not be able to emerge the following season. Sheep or swine kept in the orchard from about the 15th July would save much labor by eating the fruit as soon as it fell to the ground, and poultry would render good service by devouring the fruit, maggots and puparia beneath the trees. The larvæ do not penetrate more than an inch or an inch and a half beneath the surface, so would easily be scratched out and found by chickens. Prof. Harvey draws attention to some important facts in the habits of the apple maggots. He points out that the perfect insects are rather sluggish and that the species does not seem to spread very rapidly in a new locality from orchard to orchard nor even from tree to tree in an orchard. He shows clearly, however, that it is a most serious pest from the way in which infested fruit is rendered quite useless for human food. The females are very prolific, each one laying from 300 to 400 eggs, and the young maggots hatching inside the apples are inaccessible to any wholesale method of treatment such as spraying. Up to the present no parasites have been detected feeding on the insect. Almost all varieties of apples are liable to attack and as many as a dozen maggots have been found in a single fruit. Under remedies, he says, "The only chances are to destroy the larvæ and pupæ. The larvæ are found abundantly in windfalls, and the pupæ in bins and barrels where fruit has been stored. Destroying windfalls would prevent the maggots going into the ground, and burning refuse from bins and barrels would dispose of those in stored fruit. These methods are practical, easily applied and should be rigidly enforced." "There is no lazy way to check this insect. It will have to be done by a direct, squarely-fought battle. We firmly believe we have in the careful destruction of the windfalls the means of destroying the pest."

The Cigar Case-bearer (*Coleophora Fletcherella*, Fernald) has been decidedly less abundant this season than for three or four years previously. Good results from spraying are reported by Mr. Harold Jones of Maitland, Ont., who noticed the young caterpillars moving on the bark on May 2 and at once sprayed with kerosene emulsion and practically cleared his orchard. Mr. W. H. Little, of Trenton, Ont., says it has been numerous in his orchard for about four years, but has kept it within control by spraying with Bordeaux mixture and Paris green. The insect is reported from Goderich and Port Hope in restricted localities. It was found at the latter place by Dr. Bethune in numbers upon an isolated apple tree against a fence, a long way from any orchard or garden. At Port Hope some specimens of a small parasite were bred from the cases by Mr. Wm. Metcalfe. These have been identified by Mr. W. H. Ashmead as *Microdus laticinctus*, Ash.

The Pear Slug (*Selandria cerasi*, Peck), this old enemy of the fruit grower, seems to have been unusually abundant during the past summer in all parts of the Dominion where prunus fruits are grown. Mr. L. A. Woolverton states that the second brood is more troublesome than the first and suggests that the reason is because at the time of the year when it appears, fruit growers are so busy picking and marketing fruit that it is almost impossible to find time to spray with Paris green.

After the exceptionally heavy crop of all fruits throughout the province this year, it is almost certain that the next season's crop will be light; the careful grower who attends to all such *little* matters as spraying will then most certainly reap a rich harvest at the expense of his less thoughtful neighbours. It is in the off years that the skill of the horticulturist is called forth; he cannot, it is true, always make his fruit trees set fruit and bear, but he can in many instances by skilful management materially improve the quality of his crop, and it is in years when the crop is small that he has the greatest latitude to show his superiority over the easy-going grower who trusts to luck and lets things come as they may.

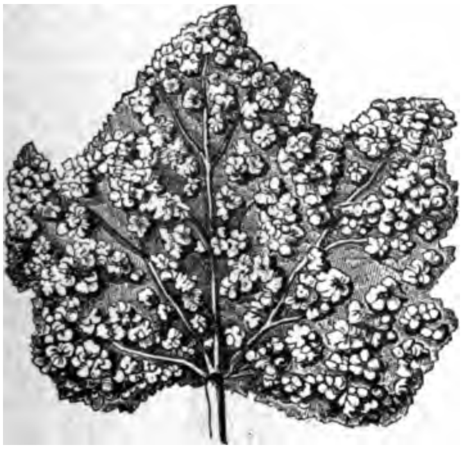


FIG. 68.

Grapes have suffered somewhat from the Phylloxera. Mr. Woolverton found the leaf gall inhabiting form unusually abundant throughout the Grimsby district. In many cases hundreds of vines on a plantation had their foliage covered with the galls of the louse—Fig. 68. In the September number of the *Canadian Horticulturist* appeared a figure of a branch of a grape vine infected by Phylloxera. There are few insects as well known as the notorious *Phylloxera vastatrix*, Planchon, which has been the cause of such enormous losses to the grape growers of France, Italy, Spain, and other countries in Europe. This pernicious insect is a native of America, whence it was introduced into Europe and where it now commits terrible ravages, far exceeding anything that has ever been recorded here in its native country. The life-history was worked out by the late Dr. C. V. Riley and has appeared in several of our previous reports. There are two forms of this insect with very different habits. The first produces greenish red or yellow galls on the foliage, as shown in the illustration kindly lent by the editor of the *Canadian Horticulturist*; the other, which is the most injurious, attacks the roots, causing swellings on the young rootlets, which

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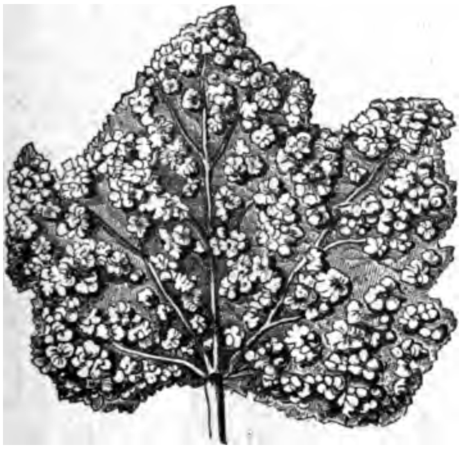


FIG. 68.

finally decay and thus the root system of the vine is destroyed. The winter is passed in a dormant condition on the roots. In spring there are five or six generations of wingless females, all of which bear young without the intervention of males. In July some winged females are produced which leave the roots and fly to other vines, when each one lays a few eggs of two different sizes, from which are produced in about a fortnight perfect males and females. These are born for no other purpose than reproduction and are without means of flight or of taking food. Each female lays one egg, from which comes an egg-bearing, wingless female, thus beginning a new circle of existence. The winged females which are first seen in July continue to appear throughout the season and are most abundant in August.

Occasionally the underground form leaves the roots and produces galls on the leaves. These are more abundant in some seasons than in others, as during the past summer—but the Grape Phylloxera cannot from past experience be considered a serious pest in Canada, although at rare intervals there has been a loss of many vines in some vineyards which have been badly infested. The only remedy which has been adopted in this country has been the destruction of badly infested vines or the removal of gall-bearing leaves from those which are less severely attacked.

Another insect which has been locally troublesome on grape vines in western Ontario is the Grape Thrip (*Erythroneura vitis*, auct.). Mr. Woolverton thinks that it is increasing steadily year by year. It has been treated effectively by spraying vines carefully with kerosene emulsion before the young of the first brood acquire their wings.

The two broods of the Strawberry Leaf-roller (*Phoxopteris comptana*, Frol.) Fig. 69, did considerable injury to strawberry beds around Picton, Prince Edward County, in June last and in the autumn. Luckily for Canadian growers of small fruits it is a rather rare occurence for this insect to be sufficiently abundant to attract notice, but in some of the northern United States it is considered the most destructive of the enemies of the strawberry grower. The caterpillars were found on the strawberry plants towards the end of June and were not noticed until they had injured one field of four acres sufficiently to give the plants the appearance of being attacked by a severe blight or as if fire had been over them. The caterpillars when full grown are about one-third of an inch long and vary in colour from yellowish-brown to dark-brown or green. They fold the leaves of the strawberry by drawing the upper surfaces together and fastening them with strands of silk. They then eat away all the green inner surface of the leaves, giving the beds a brown and seared appearance.

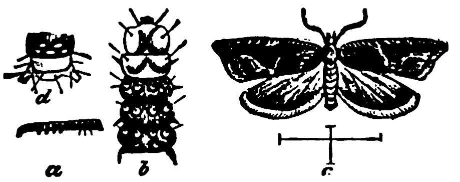


FIG. 69.

Mr. John Craig, of the Central Experimental Farm, who visited some of the Picton plantations on the 4th of July last, found that many of the caterpillars were full grown and ready to pupate; others, however, were small and would not turn to chrysalids for certainly a week or two later. Moths emerged at Ottawa from infested leaves sent from Picton between July 15 and 25, a period which would probably be extended at any rate till the end of the month in the fields. Eggs laid by this brood of moths produced caterpillars which again attacked strawberry beds severely at Picton in the autumn. As a remedy for this insect it has been recommended to mow off and burn the leaves of infested beds directly after the fruit is picked. The leaves containing the caterpillars or chrysalids, would soon dry up and would burn easily. That cutting off the leaves at this season can be done without injury to the plants has been proved by Mr. Craig in some experiments for controlling the strawberry rust. (See *Experimental Farm Report*, 1895, p. 113). It must be done of course before the moths begin to emerge. The second brood can be treated much more easily. When beds are known to have been infested by the spring brood, the plants must be sprayed or dusted with Paris green during August, so that the young caterpillars may be destroyed as soon as they hatch. Should the injuries be noticed only late in the season when the caterpillars are well grown, burning the foliage may again be resorted to. The occurence of this insect at Picton was mentioned in the *Canadian Horticulturist* for July last in a letter by Mr. Craig and the remedy of burning the foliage recommended.

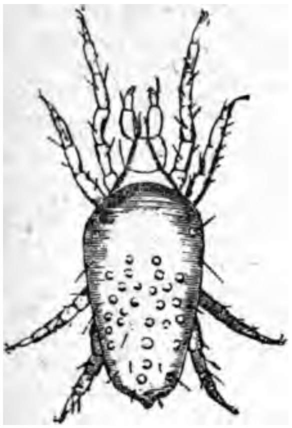


FIG. 70.

Red Spiders (*Tetranychus*, sp.) Fig 70, have been abundant and very destructive in many places particularly during the hot weather in August. There are doubtless many species of mites included under the general head "Red Spider." These minute plant-feeding mites are extremely difficult to control—when the weather is dry and hot. Frequent waterings with a hose where possible have a good effect, and sweet peas in several gardens at Ottawa were saved in this way. Dusting with sulphur also had a marked influence on the mites. Kerosene emulsion applied early to plants known to be infested was perhaps the most fatal remedy, but in large fruit gardens upon black currants and raspberries severe injury was done both by the mites and the frequent applications of the emulsion to the enfeebled foliage. As yet it must be acknowledged no practical remedy has been discovered for these pests when they are abundant and during hot, dry summers.

The Black Peach Aphis (*Aphis persicæ niger*, E. F. Smith), appeared last year for the first time in Essex County. This year there has been no complaint from that locality; but I fear that peach-growers from not recognizing the danger of this insect are failing to report its presence. Another occurrence was discovered near St. Catharines in a newly set peach orchard. The owner of the orchard, on having his attention drawn to it, promptly rooted up the trees and destroyed them.

SOME BEETLES OCCURRING UPON BEECH.

BY W. HAGUE HARRINGTON, F.R.C.S., OTTAWA.

When so many of our forest, shade and orchard trees are defoliated and disfigured by an endless succession of insect pests it is satisfactory to find one of our most beautiful and valuable species comparatively free from such attacks. At the close of summer the stalwart, handsome beech will be found with its raiment of bright, glossy foliage almost as fresh and unspotted as in springtime, while its neighbours, the maples, elms, etc., are more or less naked and threadbare. Yet, favored as it is, there are several species of moths whose caterpillars find the tough leaves not unpalatable, such as *Hyperetis nyssaria*, A. & S., whose larva was described by Prof. Saunders in the Canadian Entomologist, vol. iii., p. 209, and the pretty little casemaker, *Incurvaria acerifoliella*, Fitch, which at times so seriously infests the maples. (See Trans.-Ottawa Field Naturalists' Club, No. vi., p. 353.) The trunk when injured, or when the trees become weakened by age, is riddled by the boring larvæ of the large Horntail, *Tremex columba*, Linn, one of the most striking of our Hymenoptera, and becomes gradually the feeding ground of a variety of insects. The majority of the insects, however, which I have found infesting this tree belong to the order Coleoptera, and while but few of the species do serious injury to the tree when it is still vigorous, it may not be uninteresting to make a brief record of the species which have been noted by myself, or which have been recorded by Dr. Packard in his Forest Insects (Fifth Report of the United States Entomological Commission, pp. 513-520.)

Trogositidæ.

1. *Trogosita corticalis*, Melsh. An elongated, flattened, brownish beetle, about three-fifths of an inch long, with finely striated elytra, found under the bark of old trees; cannot be considered injurious.

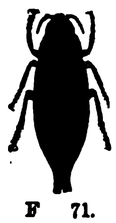
2. *Grynocharis 4-lineata*, Melsh. A more flattened black beetle, about twice as wide as long, and very variable in size, from a little over two tenths to nearly four-tenths of an inch long. Each elytron has four raised lines, between each pair of which is a double row of punctures. This beetle is found under bark with preceding, and is also harmless.

Elateridæ.

3. *Corymbites cruciatus*, Linn. A handsome "click-beetle," whose larva is one of the wire worms which feed in decaying wood, and which has always been found by me on, or in the vicinity of, beech. It is about half an inch long, head black with the exception of the reddish mouth parts, thorax black with a bright red stripe down each side above and below, body beneath black margined with red, elytra yellow with sutural stripe, short humeral stripe and sinuate band behind middle, black. The black sutural stripe and the transverse band form the cross from which the name is derived.

Buprestidæ.

4. *Dicerca divaricata*, Say. A brownish or blackish bronzy beetle, of rather stout build, from three-quarters to almost an inch long. (Fig. 71.) It is a well known pest of such trees as the maple, apple, etc., its larvæ being one of the "flat-headed" borers, so-called because the thoracic segments (next the head) are much wider than those that follow. It is sometimes quite abundant on old trees, and in May and June can be found ovipositing therein. Some entomologists consider that the beech was the original food-plant of the insect.



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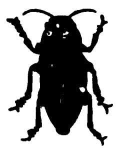

Fig. 72.

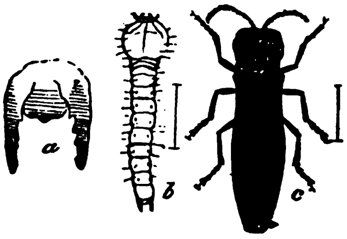

Fig. 73.

5. *Chrysobothris femorata*, Fab. This common borer of the apple tree (Fig. 72) has also been recorded (Riley, 7th Rept., p. 72) from beech, although of all the forest trees in this neighbourhood it seems to prefer the hickory. The oak, maple, mountain ash, linden and box elder are also said to be attacked by it. It is a flattened beetle, somewhat over half an inch long, of a metallic, bronzy colour with some greenish reflections, and the face of the male is bright green. It has been often mentioned in our Reports.

6. *Chrysobothris sexsignata*, Say. This beetle very closely resembles the preceding, but is slightly smaller, and is more rare with us. Mr. Chittenden records (Ent. Amer. V., p. 219) cutting a specimen from a beech tree. This beetle has also been found in yellow birch (Packard l. c., p. 485

7. *Agrilus bilineatus*, Web. This pretty little beetle is more elongated and in shape strongly resesembles the Red-necked Agrilus *(A. ruficollis)* (Fig. 73) which forms the gouty swellings on raspberry canes (Fig 74). It is about three-tenths of an inch long, and the upper surface is black, or greenish black, with a line of golden pubescence on each elytron, and on the margin of the thorax (these lines sometimes rubbed off or wanting); below the colour is coppery. I have taken it upon beech and believe it to infest this tree. Dr. Packard and Prof. Riley have each found it infesting oak.

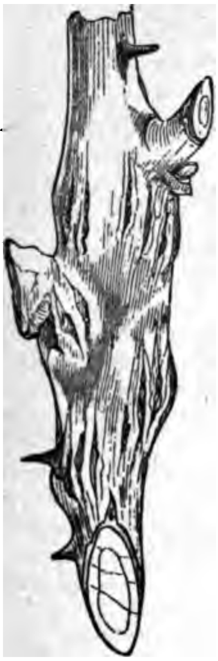

FIG. 74.

8. *Agrilus interruptus*, Lec. This species much resembles the preceding, but is somewhat smaller and more slender. Its colour is more of a bronze, and instead of the line of pubescence it has a minute golden dot toward the tip of each elytron. I have found it upon beech, birch and hickory, but do not find in my books any records of the trees upon which other collectors have found it.

9. *Brachys æruginosa*, Gory. The larvæ of this little buprestid have been found by Mr. V. T. Chambers (Packard. l. c., p. 519) to mine in the leaves of the beech. The posterior segments are not so tapering as in the larvæ of the species previously mentioned. The beetle very closely resembles the following in size and appearance.

10. *Brachys aerosa*, Melsh. (*B. terminans*, Lap) is rather a common beetle with us, and is found most frequently upon the basswood, but also occurs upon elm, beech, etc, and may mine in the leaves of all these trees. It has been bred by Prof. Gillette from the leaves of poplar (Can. Ent., vol. xix., p. 138). The beetle is only about one-sixth of an inch long, of a sub-triangular or narrow shield-shaped figure; general colour coppery, the elytra purplish and ornamented with pubescence, which forms a band across the tips. We have a larger species, *B. ovata*, Web., which occurs upon oak.

CLERIDÆ.

11. *Thanoclerus sanguineus*, Say. This little beetle is sometimes abundant under the bark, and quickly attracts attention by its bright red colour. It is one-fifth of an inch long and quite narrow; the head and thorax a duller red than the elytra and legs. It is very active in its movements, and when disturbed quickly hides in a crevice or the burrow of some borer. It is rather beneficial than injurious to the trees upon which it occurs, as it preys upon other insects.

PTINIDÆ.

12. *Eucrada humeralis*, Melsh. I have found this beetle under the bark of beech, and as most of the members of this family are destructive insects this may probably be classed as such. It is about one-fifth of an inch long, of brownish colour, with a reddish spot on each shoulder of the elytra which have several rows of punctures.

13. *Ptilinus ruficornis*, Say. This small cylindrical beetle which is very frequently found boring "pin-holes" in oak and maple, has also been found by me to do the same in old beech trees. The female is one-tenth of an inch long, brownish, with the head bent down under the globose thorax, the elytra faintly punctured. The male is only about half as large and is easily recognized by his prominent red antennæ (which give the species it name), the outer joints of which have long leaf-like projections.

LUCANIDÆ.

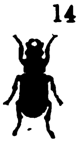

FIG. 75

14. *Platycerus quercus*, Web. This beetle and the two following belong to the stag-beetle family, in the males of which the mandibles, or jaws, are sometimes wonderfully developed. In this species they are as long as the head and turned up and irregularly toothed at the point (Fig. 75.) The beetle is about half an inch long, rather flattened, bronzy black in colour, shiny and feebly punctured. The female is lighter in colour, being nearly brown above; the legs and under surface reddish. The larvæ like those of the following species live in decaying wood of various trees.

15. *Platycerus depressus*. Lec. This species differs from the foregoing in being slightly larger, blacker and with the elytra more coarsely striate and punctured. The mandibles are shorter and stouter.

16. *Ceruchus piceus*, Web. This is a very common insect in old beech logs and stumps. It is much more stoutly built, and is very variable in size; from two-fifths to three-fifths of an inch long, the males being much larger than the females. The head is large, as wide as the thorax, and with a deep frontal depression. The jaws of the male are as long as the head, and with a strong inner tooth about the middle.

SCARABÆIDÆ.

17. *Dichelonycha elongata*, Fab.—A rather cylindrical beetle; four-tenths of an inch long; the general colour testaceous or yellowish; head flattened above; thorax more or less pubescent; wing covers with a greenish reflection, more pronounced in the males; under surface hoary, with scale-like hairs; tips of hinder legs sometimes blackish. This beetle and two or three closely allied species difficult to separate from it, feed in the perfect state, on a variety of trees. They much resemble in size and general appearance the Rose beetle, *Macrodactylus subspinosus*, Fab., which belongs to the same family but is, however, smaller and less corpulent. I have found them not infrequent on beech.

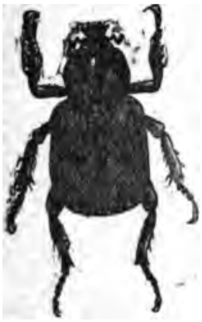

Fig. 76.

18. *Osmoderma scabra*, Beauv.—This is a large stout beetle (Fig. 76) of a dark bronze, or metallic brownish colour. Its length is nearly an inch, and it is about half as wide (across the elytra). The head is small, squarish and depressed above; the thorax rounded and irregularly punctured; the elytra irregularly wrinkled and striated. When alive this beetle diffuses a strong odour, which much resembles that given off by Russian leather. The larvæ feed in the decaying wood of old trees, and are fat white grubs much like those of the May-beetles. They construct large oblong cocoons from the particles of decayed wood, in which the grub pupates and finally becomes a beetle. It is probable that the closely allied species *O. eremicola*, Knoch., also breeds in old beech cavities.

SPONDYLIDÆ.

19. *Parandra brunnea*, Fab.—The shape of this beetle and its large mandibles give it a great resemblance to some members of the Lucanidæ (Stag-beetle family), but it is at once distinguished by having the antennæ straight and tapering to the tip, instead of terminating in a leafed club. It is variable in size, from five-tenths to eight-tenths of an inch in length, and of an almost uniform reddish or yellowish brown colour. The grubs live in the wood of stumps and old trunks of various trees, the beetles being found under the loose bark, although they are seldom numerous.

CERAMBYCIDÆ.

20. *Smodicum cucujiforme*, Say.—This beetle I have not seen, but it is one of the smaller species of the longicorns, being only three-tenths of an inch long. The following is part of the original description of the species: "Body depressed; head with a slight

rufous tinge, antennæ rather shorter than the body, tinged with rufous; thorax longer than broad, obtusely contracted each side, rather before the middle; elytra irregularly punctured, without elevated lines; thighs dilated." Mr. Schwarz records finding it under the bark of beech. (Packard l. c. p. 79).

21. *Dryobius sexfasciata*, Say.—Mr. C. G. Siewers records (Can. Ent. vol. XII., p. 139) finding five examples of this handsome beetle under the bark of beech. The grub is stated by Dr. Fitch to be much like that of the common elm-borer, *Saperda tridentata*, Oliv., but larger. The beetle is also of nearly similar form to that species, the length about three-quarters of an inch; colour black, and each elytron with four oblique yellow bands.

22. *Xylotrechus quadrimaculatus*, Hald.—This beetle much resembles in shape and colour a longicorn, *Neoclytus erythrocephalus*, Fab., which is often found on hickory. That species, however, is smaller, and has longer legs; the yellow markings are also different. *X. quadrimaculatus* is half an inch long, and of a reddish colour; head small; thorax globose with two bright yellow spots on front margin and less distinct markings on the hinder margin; elytra with somewhat yellowish tinge and faint oblique yellow lines; legs slender and pale reddish. The only specimen of this beetle which I have taken at Ottawa was found resting on the branch of a beech in June.

23. *Cyrtophorus verrucosus*, Oliv.—This is a common beetle, very ant-like in appearance, which occurs upon various trees, and very frequently upon flowers, such as spiræa, goldenrods, etc. Mr. Chittenden has bred examples from beechwood. It varies considerably in size, but average examples are four-tenths of an inch in length. The head is small and sunken to the eyes in the thorax; the antennæ are nearly as long as the body and very slender, the third joint having a strong spine at the tip. Thorax rounded and humped above, very closely and finely sculptured. The elytra are angulated at the shoulders, and each has an elevation near the base, along which runs diagonally a narrow white line, behind which are two less oblique lines, the last being almost transverse. Sometimes the beetle is all black, with the exception of these white lines, and the partly reddish legs, but many specimens have the basal half of elytra (between the thorax and transverse white line) reddish, as also the corresponding under surface and the legs.

24. *Centrodera decolorata*, Harr.—This is a much larger longicorn of which I have taken one example on beech. It is about an inch long, of a chestnut red colour, except the elytra and abdomen, which have a more yellowish tinge. Head moderate in size, and narrowed behind the large, coarsely granulated eyes into a neck. Thorax small, narrowed in front and strongly angulated, or subspinose, in the middle. Elytra at base nearly twice as wide as thorax, and tapering very little toward the rounded tips; coarsely punctured at base, and more finely toward tips, Antennæ reaching to middle of elytra, dusky except basal joint. Legs moderately long and stout.

25. *Toxotus Schaumii*, Lec.—A very handsome longicorn of which one of my examples was taken on a small beech, in a beech grove, in July. It much resembles in size and shape the preceding species, but the thorax is less strongly angulated, and the elytra taper more. With the exception of a wide red band on all the thighs it is entirely black.

26. *Anthophilax attenuatus*, Hald.—One example of this rare longicorn was taken by me in an old beech log in May. It is in general shape much like the foregoing and about three-quarters of an inch long. Head and thorax black; antennæ and legs slender and reddish; elytra brownish and mottled with whitish pubescence.

27. *Leptura subhamata*, Rand.—An example of this pretty and variable species was also taken in an old beech log, and I have taken it likewise on oak. It averages about half an inch in length, and is of rather slender build. The head is small and narrowed to a neck; antennæ long and slender, the joints partly yellow at base. In the male the thorax is black, but in the female it may be either black with a yellowish side stripe, or yellowish with a black central stripe. The elytra of the male are black, with a yellow

stripe on each reaching from the shoulder to beyond the middle, and crossed by a black band so as to form a cross. In the female they may have the same pattern, only the yellowish stripes are larger, or the elytra may be yellowish with a narrow black rim and a band across the middle. Under surface of male, and most of legs, black; under surface of female and legs mostly yellowish.

28. *Goes pulverulentus*, Hald.—This beetle has been recorded by Dr. Horn as very destructive to living beech trees, in the larger branches of which it bores tunnels several inches in length. It may, therefore, be considered one of the most injurious insects infesting this tree, and, as I have previously recorded (Ann. Rept., xiv p. 48), there is little doubt that it also inhabits the hickory. It is a rather large beetle, and in shape closely resembling the female of the common pine-borer, *Monohammus confusor*, Kirby, the smaller specimens of which it equals in size. Length from three-quarters of an inch to about an inch; antennæ slender and slightly longer than body; thorax cylindrical, with a sharp spine on each side; elytra wider than thorax; legs moderately long and stout; colour brownish, but having a hoary appearance, especially beneath, from short white pubescence.

29. *Acanthoderes quadrigibbus*. Say.—This species has been recorded by Mr. Schwarz as boring in the dry twigs of beech and oak. It is a pretty little beetle, quite different in shape from the preceding. Its length is about three-fifths of an inch, and it is rather broad and flattened in proportion to its length; thorax tuberculate above; legs short; the thighs rather stout; elytra with mottled whitish and brownish pubescence and with a sinuate whitish band before the middle.

30. *Leptostylus macula*, Say.—This species which infests the butternut and chestnut has also been observed by Mr. Chittenden to inhabit the beech. I have found it upon butternut, maple and balm-of-gilead, but more frequently upon hickory. It does not differ very greatly in appearance from the preceding beetle, but is smaller and less tuberculate. Individuals vary in length from one-fifth to three-eighths of an inch, colour brownish; thorax with a white stripe on each side, bordered above by an interrupted brown line; legs banded with white and brown; elytra coarsely punctured and imaculate with brown spots, and banded with white behind the middle; antennæ long and slender.

31. *Hoplosia nubila*, Lec.—This species, according to Mr. Schwarz, also bores in the twigs of beech. It is longer and narrower than the preceding insect. Length three-eighths to one-half of an inch; thorax with lateral spines; antennæ longer than body and slender; elytra longer and almost parallel sided, truncate at tips instead of rounded: colour brown, with mottling of whitish pubescence, giving a spotted appearance, and leaving irregular bands on the elytra.

RHIPIPHORIDÆ.

32. *Pelecotoma flavipes*, Melsh.—A small, slender beetle which on one occasion I found quite abundantly on an old beech tree. As the members of this family are parasitic in their habits, it may probably be considered as a beneficial species, preying perhaps, upon some of the inhabitants of the tree.

OTIORHYNCHIDÆ.

33. *Pandeletegus hilaris*, Hbst.—This beetle belongs to a family of weevils, or snout-beetles, which contains some well-known injurious insects. Harris records it as boring in oak, and occurring on all trees from May to September; while Mr. Chittenden notes it as common upon the beech. I have not found it at Ottawa yet, but have received specimens from Mr. Johnston, of Hamilton. It is quite small, being only from one-eighth to one-fifth of an inch long; colour pale-brown, with some greyish and black stripes; beak short and broad; thorax coarsely granulose; elytra with rows of deep punctures.

CURCULIONIDÆ.

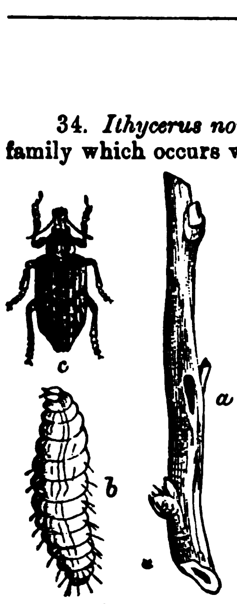

Fig. 77.

34. *Ithycerus noveboracensis*, Forst —This species is the largest representative of the family which occurs with us. It has been found at times a serious pest in orchards, injuring apple, peach, pear, plum and cherry (see Insects Injurious to Fruits, Saunders, p. 196.) According to Riley it infests the oak, in the twigs of which the larva tunnels. With us it seems to inhabit the beech, upon which I have frequently taken it, in the month of June. At Chelsea, a few miles from this city, it was very abundant one season, individuals being observed on every tree examined in a grove of beech. It may be readily recognized among our snout-beetles by it greater size, being five-eighths of an inch long, and robust. Beak, broad and stout with a ridge down the centre; thorax cylindrical, a little narrowed in front; elytra twice as wide as thorax, and declivous or pinched in at the apex to fit the corpulent body; colour greyish; the thorax with three indistinct pale stripes, and each elytron also with three whitish lines, interrupted with black spots, lower surface and legs whitish. Fig. 77.

35. *Cryptorhynchus bisignatus*, Say.—A pretty little brownish weevil, with an oblique white dash on each elytron, much resembling in shape the Plum Curculio but smaller and not tuberculated. Mr. Chittenden has found it upon both oak and beech trees and believes that it lives under the bark of these trees.

36. *Acoptus suturalis*, Lec.—Mr. Chittenden has taken specimens of this beetle from beech wood. It has been recorded by me (Ann. Rept. xiv., p. 50) as boring in hickory, and the following description was there given of it. A small, black beetle (length one-eighth of an inch), densely clothed beneath and more sparsely above with short yellowish hairs. The elytra are striated and in unrubbed specimens have a wide band of yellowish pubescence across the base, and a narrow one near the tips, which are black, as is also the space between the bands; a white line along the suture interrupts the basal band.

CALANDRIDÆ.

37. *Phlæophagus apionoides*, Horn.—This is a very small and narrow blackish weevil about an eighth of an inch long, with punctured thorax and striated elytra, which Mr. Chittenden found to occur upon the beech with the species just mentioned, and which he believes to breed in the wood likewise.

36. *Phlæophagus minor*, Horn —As its name indicates this species is smaller than the preceding, but otherwise closely resembles it, except in being of a paler colour, a reddish brown. Mr. Chittenden states that it breeds in the beech and also occurs on the elm.

38. *Stenoscelis brevis*.—This species which is stated to breed in the wood of beech has been found by me also infesting oak, hickory, maple and poplar. It is a black cylindrical beetle, one-eighth of an inch long, with faintly punctured thorax and striated elytra; beak short and smooth, giving it much the appearance of some of the bark-borers which belong to the next family.

SCOLITIDÆ.

39. *Monarthrum fasciatum*, Say. This little species bores in the living tree in the same manner as the Apple Bark-borer (*M. mali*, Fitch) which infests the apple, and which it much resembles.

40. *Xyleborus obesus*, Lec.—This is also a small insect which bores in the living tree, and which much resembles a destructive species (*X. pyri*, Peck) which attacks the pear and which has been named the Pear Blight Beetle.

NOTES ON THE SEASON OF 1896.

By J. Alston Moffat, London, Ontario.

The season commenced early and gave promise of being a good one for the collector, but soon showed symptoms of failing to fulfil its promise. The conditions here were unusually favorable for the production of luxuriant vegetation, and might have been considered equally so for the maturing of insect life, and yet the season was marked by a noticeable absence of that profusion usually seen in the early part of the summer particularly. And this seemed to be the experience of all the regular collectors I met with. When asked as to their success, the unvarying reply was, "There is nothing to be got." And yet, on the other hand, Mr. Bryce, an electric light trimmer, made during the season a large and varied collection of moths; not damaged ones taken out of lamps, but fresh specimens in good order, taken mostly at rest in the vicinity of the lights. When looking at that collection one felt like saying that there could have been no scarcity of good material, but it only proved the value of electric light as a means of concentrating them at particular places for observation, and also, that insects have to be somewhat abundant to become conspicuous. The only moths that attracted my attention about the lights were species of *Crambidæ*.

The climatic conditions in the southern portion of Ontario were remarkably diverse within short distances, the western section having a superabundance of moisture, whilst the eastern section was proportionately dry, vegetation of all kinds there suffering severely from want of rain; yet there were two injurious insects that seemed to prosper equally well under either condition, namely, the Colorado potato beetle and the imported cabbage butterfly, both being unusually plentiful.

The newspapers reported grasshoppers as causing considerable damage in specified localities, but within the range of personal observation, they were noticeable mostly for their absence. Even in the dryest localities visited by me they could not be called abundant.

As was to be expected, after such a superabundant overflow of *Hadena arctica* last season, the next would be one of corresponding scarcity of the same species, and so it proved to be. Three specimens of it came under my observation, and three only. Many writers have a fondness for giving columns of figures that are perfectly appalling, illustrative of the natural cumulative increase of insects in a given number of generations, and the unsuspecting reader taking that as the unvarying rule in nature, reasonably concludes that if any species is particularly plentiful one season, it must necessarily be much more so in the following one, and consequently anticipates its advent with more or less alarm; but nature, which is full of surprises, has an easy method of confusing arithmetical calculations, or even of running counter to them. Long continued observation has led to the conclusion that the rule in nature is rather that an unusual outbreak of an insect in one year will be followed by a more than usual scarcity of the same species the next.

Two things are necessary for an abundance of any insect form. First, plenty of eggs; second, favorable conditions for the maturing of the same, in which must be placed an absence of living foes. A noticeable outbreak of a destructive insect is not necessarily preceded by an unusual number of producers. If all the eggs of any species of insect in any year were to come to maturity, there would undoubtedly be a noticeable increase of that species. But as a rule, it is a very small percentage of the ova of any insect that reaches maturity, many natural causes combining to reduce their numbers all along the line of their advance towards that consummation, and thus the balance is maintained between contending interests. This is what is known in scientific phraseology as "the struggle for existence," a delightfully brief but vague expression that covers much ground but explains nothing.

It would be a great satisfaction to be able to give a direct answer to the question so frequently put as to the cause of the abundance or scarcity of some insects at particular times, but with creatures that work so much in secret as insects do, it is probable that it can never be done. When an unusual outbreak of any injurious insect occurs we can say positively that the conditions for its coming to maturity had been particularly favorable, but that includes all the climatic conditions, whether these were wet or dry, cold or hot, steady or fluctuating, and as these influence different species in different ways, the uncertainty is the greater; then there is food supply in the past as well as the present; the absence of predacious enemies, parasitic fungi and such like; they may also cover the character of the cultivation of that locality, as that may form a harbor and encouragement to the increase of pests,—an extent of varied knowledge which no one is likely to be in a position to possess. And so with their absence or great scarcity in other years, we can say positively that the conditions were not favorable, but just what these were it may be impossible to specify, especially by one who was not in the locality and had no opportunity of observing the conditions.

The first really serious and wide-spread outbreak of the army-worm, *Leucania unipuncta*, Haworth, in Canada, having occurred the last season, was the means of directing general attention to that destructive insect; and was productive of much newspaper correspondence. I had an opportunity of seeing the worm in the flesh, for the first time to my knowledge, and inspecting its work; and this is how it was obtained:

Being on a visit to Hamilton in July, I was invited to spend the evening of the 22nd, at Boulderwood, the charming summer residence of Mr. and Mrs. B. E. Charlton. It is situated on the brow of the mountain, adjoining the north or city side of the asylum grounds. On our way up, Mr. Charlton informed me that the army worm had invaded the asylum grounds, and was destroying the crops; and he proposed that after dinner we should visit the locality, and survey the invading army; which we accordingly did. We obtained the guidance of the farmer of the grounds, who led us to the infested field, which was at the extreme southern end of the asylum farm. He said they were first noticed in a field of oats, and on the other, or southern side of the road from his, and that the owner as soon as he knew they were there, cut his oats and shocked them in the field. The next day when he examined his shocks he found the ground under them a mass of worms mingled with oats. The asylum farmer at once ordered his to be cut, but had them carted to a far distant field and there put up in shocks.

The crop next north of the oats that had been cut and removed, was spring wheat. There we had evidence of what the worms could do. Not a loose leaf was to be seen in the field; the straw standing quite naked. It had begun to ripen, which probably had saved it and the heads from attack, as some of the short and greener ones showed signs of having been nibbled at. We found a number of the worms under clods, but the farmer expressed surprise at their being so scarce, as compared with the previous day, when a pint or more of them had been taken in a very short time, which had been wanted for exhibition purposes. Probably the bulk of them had gone to seek fresh pasture, as there was not a green leaf in that field left for them to eat. Some of those taken seemed to be full grown, and may have been preparing to pupate, as chrysalids were found. During the search Mr. Charlton found a creature which was to us of doubtful parentage. I thought I recognized it as something I ought to know, but could not say what at the time. Having surveyed the situation to our satisfaction; and Mr. Charlton having secured three of the largest worms in a box, the unnameable creature and a chrysalid; we returned to his residence. After these had been looked at by the residents and visitors assembled, the time came when I had to leave; Mr. Charlton kindly said I might take the box and its contents, which I was very pleased to do; so I put it in my vest pocket, which it just fitted. Upon reaching my place of abode, I took out the box to show my friends the army worms; when I opened it, I found the largest one had disappeared, except the head and shrivelled skin, which was about the size of a grain of wheat, whilst the unnameable creature had another one by the middle, and was quietly engaged in absorbing its internal economy with unmistakable satisfaction. This disclosure of its habits at once suggested to me that it was the larva of some predaceous beetle, probably an *Harpalus*, and that I had seen an illustration of it somewhere. Upon returning to London and making search, I found its exact counterpart on an enlarged scale in "Saunders's Insects Injurious to Fruit," page 185, which is here reproduced, Fig. 78.

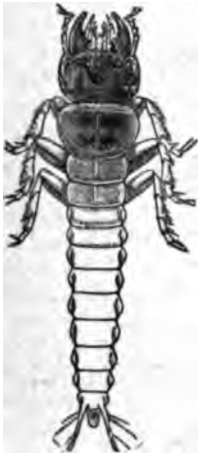
FIG. 78.

During the next day, the *Harpalus* larva rested quietly, two worms seemingly being enough to satisfy its cravings for one day; whilst the remaining worm was very restless, no doubt from want of food. In the evening, being in company the army worm was introduced in the conversation, when I remembered that I had the box in my pocket, I took it out to show the worm, but there was not the vestige of a worm left, and the *Harpalus* larva was rushing frantically round in the box in search of more. I kept it that night to see if it would attack the chrysalid, but it did not, so I gave it its liberty next morning in consideration of the good it might do.

A great deal of romance has been written upon the army worm. Its sudden appearance in vast and destructive hordes is well calculated to arouse the imagination of those who are usually totally indifferent to, and wholly ignorant of the habits of insects; consequently the movements of the army are to them perfectly mysterious. We read of their coming, no one knows how, or from where, of their always travelling to one particular point of the compass. Of their following a leader who directs their movements; and who gives the signal for their advance by a wag of his head; and much more of the same sort. The army worms come from eggs, like all other insects, which in this case are laid near the roots of grasses by the moth *Leucania unipuncta*; and may be feeding there in great numbers when young, without attracting the slightest attention. It is not until they are well grown that they acquire their great powers of destruction, and then the field in which they were born may not be able to sustain all of them; when the necessity to travel to other localities in search of food is forced upon them. The only really mysterious thing about their movements is, that they should keep together in a body, and go in the same direction in search of food, instead of, as is usual with caterpillars, each going in the direction that its fancy leads, independently of the others of its kind. This gregarious habit is indeed very wonderful. But food is their objective point of travel, not any particular one of the compass.

There is another destructive insect that is endowed with this peculiar habit of travelling all together in one direction in search of food, namely, the migratory locust in its mature state; and a consideration of its mode of progress in desolating a region, may assist us in forming an idea concerning that of the army worm. When we read of an invasion of locusts into a locality where there were none before, they are always represented to us as coming down from the air above, ravenously hungry, as if it had been their first stopping place for food on a long journey, a few at first, then a dense mass, sufficient at times to obscure the light of the sun, gradually becoming thinner, then passing over, not leaving any living green thing behind them. This appearance, although it may be misunderstood by the onlooker, is nevertheless quite in harmony with the actual facts of their progression. Supposing a field well stocked with locusts who have just developed mature wings and a prodigious appetite, find their food supply exhausted, and it has become needful for them to go elsewhere for more. The field next to them is untouched, those close to it enter, those behind them follow, whilst those at a distance who are as eager for food and in as great a hurry to obtain it, rise on the wing and fly over the feeders and alight just beyond them, their peculiar gregarious instinct compelling them to feed in crowds, so that those that entered the fresh field first, find themselves surrounded by a multitude which has devoured everything before they get enough; hence they in turn find it necessary to rise on the wing and make for the front again to obtain more and so having started they proceed; and the deeper and denser the advancing host, the further they have to fly to reach the front, and the more of them there are on the wing at one time, the higher some of them have to rise in the air to get over the others; and when we read of their coming down in such numbers and such force, as to remind the beholder of a hailstorm, and make him glad to seek shelter from their contact, it is in perfect accord with their mode of progress and their eager haste to obtain food; and this mass, to a beholder who could take it all in at once, would appear like a huge rolling crowd of living particles, descending in front but ascending at the rear, whilst the impelling force that keeps it going is the necessity for something to eat. And when we consider the meagreness of the supply in some localities, compared with the enormousness of the demand that always exists, we get the reason for the differences of time that they take on the way. If food is abundant, they linger; if it is scarce they pass rapidly on. When we turn our attention again to the army worm, we see that the principle and the motive are the same in both; but the one proceeds on the wing, through the air, whilst the other has to keep on the ground and go afoot; yet the front ranks will be constantly changing places with the rear, for as those in front stay to eat, those behind have to pass beyond them to obtain a share; and as the feeders are so numerous in one place, none of them get all they want, so they are compelled to move on to get some more; which completely disposes of the "leadership" theory.

Amongst the captures here of rare forms during the past season, I may mention a specimen of *Papilio Marcellus* by one person, and one of *P. Philenor* by another. *P. Cresphontes* again paid us a visit, after an absence of two years. It appears as if this southern butterfly must be either periodical in its habits, or has not yet succeeded in firmly establishing itself in more northerly localities; and is depending upon additional migrations to maintain an appearance. In the year 1893 it was more abundant, and reported from a greater number of localities, and some of these further north than ever before. In 1894 I saw a few in the early part of the season, but none later on. In 1895 I did not see a single specimen on the wing, nor was there one reported to me as having been seen. In the latter part of August, 1896, I saw a fine fresh specimen, but did not secure it, I also saw one that was taken later in the season in a damaged condition; which would seem to give promise of its being more plentiful again next year.

A specimen of *Erebus odora* was taken by Mr. Kyle, at Dundas.

The things new to this locality, recognized in Mr. Bryce's collection, were the true Carolina Sphinx, as distinguished from *quinquemaculata.* Large in size, dark in colour, and in fine condition. *Cisthene unifascia*, Grote, bright and fresh. Mr. Bryce has kindly donated a specimen of each to the Society's collection. He has also taken a single specimen of *Aspila virescens*, Hub. Also many choice varieties of less rare things, as well as several species not yet determined. Never did I see the webs of *Hyphantria cunea*, the fall web worm, so offensively obtrusive as during the past season.

In the early part of October the males of *Hybernia tiliaria*, Fig. 79, the Lime-tree Winter Moth, were in great profusion around the city. They could be seen even on frosty nights, fluttering about the lighted shop windows, and in daytime resting in sheltered places, or being driven along the street by the wind; their large sail-like wings affording ample space for catching every breeze, and being carried helplessly away by it. There was a wonderful, and particularly interesting diversity in the shade and pattern of the colour and ornamentation of their wings, which their abundance gave one a good opportunity to observe. The females I did not see; as these are wingless they would require to be sought for upon the trees.

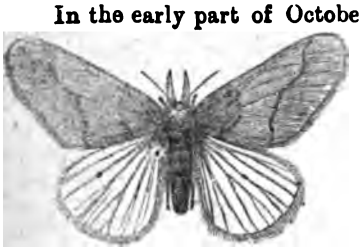

FIG. 79.

WARNING COLORS, PROTECTIVE MIMICRY AND PROTECTIVE COLORATION.*

BY F. M. WEBSTER, WOOSTER, OHIO.

In "Memoires de la Societe Zoologique de France," Professor Felix Plateau has recently given the results of some experiments carried on by himself, to determine whether, as has often been stated, the Magpie moth is really an example of what is termed "warning color." In order to solve the problem, the Professor ate several of the caterpillars, and found them to possess something of the flavor of almonds, and not unpleasant to him, but rather the reverse. Unfortunately, this experiment only proves that as against a person to whom the flavor of almonds is not distasteful, the larvæ of the Magpie moth are not warningly colored, but the real question regarding protective coloration, as against bird enemies, does not appear to be nearer a solution than it was before. Men do not feed upon the larvæ of this moth, or the moth itself, nor have we good reasons to suspect that they have ever done so, and there is no reason why these caterpillars should be, to them, distasteful, as no material protection would in any case result. The two following incidents will illustrate my point.

Species belonging to the genus Danais are, rarely, if ever, to any extent attacked by birds, and in the tropics even monkeys are said to reject them. In the United States, *Danais archippus*, (see Fig. 27, page 31), is mimicked by *Limenitis disippus*, (Fig. 80), and in other parts of the world other species of the former genus are mimicked by still other species of butterflies, some very interesting illustrations being given by Mr. Roland Trimen in his paper on "Some Remarkable Mimetic Analogies among South African Butterflies."† In the United States, *D. archippus* breeds in the north, and in autumn migrates in immense swarms to the south, where it hibernates through the winter. In "Insect Life," it is stated‡ that these butterflies are sometimes attacked in their winter quarters, and great numbers of them eaten, by a mouse belonging to the genus *Onychomys*; one of the grasshopper and scorpion mice. On an island in Aranssas Bay, on the gulf coast of Texas, the remains of at least twenty-seven individuals were found in one place by Mr. Attwater, thus showing that the species is not distasteful to this mouse, but by no mean disproving that to other animals, and to birds, it is distasteful, and for this reason mimicked by other species of butterflies. This mouse is not a persistent and perpetual enemy, and unrestrained does not threaten the extermination of the species, and protection from it has never become necessary, and is not now essential. The Harlequin cabbage bug, *Murgantia histrionica*, (Fig. 81), is a conspicuously colored, tropical species, that has made its way northward as far as Lat. 40° 48′, even the egg being white banded with black. Not only does the species feed during its entire life, in all stages of development, in the most exposed positions, but the eggs are placed in clusters equally exposed, every habit, in fact, indicating a total disregard of the presence of natural enemies of any description, thereby implying, though not proving that it is distasteful if not warningly colored. Some time since I had

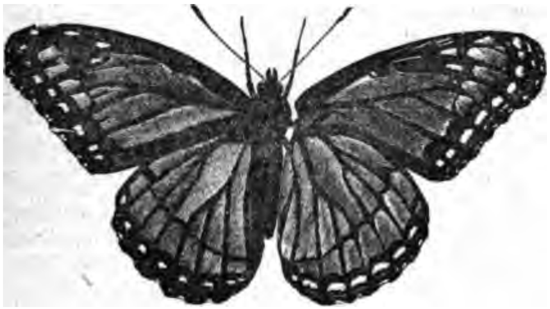

Fig. 80.

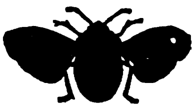

Fig. 81.

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*Read before Section F, Zoology, of the American Association for the Advancement of Science, at the Buffalo, N.Y., meeting, August 25th, 1896.

†Linn. Soc. Trans. Vol. XXVI., pp. 497, *et seq.*

‡Vol. V., p. 270.

occasion to confine a number of these bugs in a greenhouse upon cabbage plants over which a breeding cage without a bottom was placed, earth being banked up about the base of the cage. The bugs had been thus confined for a short time when during the night, mice worked their way under the side of the cage, and in the morning all that remained of the bugs consisted of a confused lot of heads, legs and fore wings, the mice having clearly eaten the confined bugs during a single night. Still, as against persistent and continual enemies these bugs may be and probably are distasteful, mice being only occasional or accidental enemies.

In commenting on the experiments of Professor Plateau, "Science Gossip," perhaps somewhat overestimating the value of the results obtained, says :— "It would indeed be well if all the examples of 'warning coloration' were subjected to as careful an examination. Equally cautious also should naturalists be before accepting examples of 'mimicry' among animals and plants In some cases the so-called 'advantageous mimicry' falls to the ground, for the insect which is supposed to imitate one of its fellows appears at quite a different time of year from it."

Now, caution is a grand virtue, and should be, always, the investigators watchword, but to be over cautious is to cheat ourselves and each other out of the truth, which practically amounts to little less than carelessness. He who cautiously winnows the grain, will be as careful that none is blown over with the chaff as he will be to keep the latter from falling back into the cleaned grain, as, in either case, his work will be but poorly done.

By the way, has it ever been settled, beyond question, that both the species protected and the one protecting must occur, interspersed together, over the same area, and at the same time of year ? Would either the ornithologist or entomologist be greatly upset if he were to find that birds which had learned, by experience, in spring and while yet very young, to shun insects of certain peculiarities of colour and movement, or which appear to them to possess such characteristics, should continue to follow the same course in late summer or autumn ? How soon do birds forget past experiences, and cease to profit by them ? After having learned that certain insects, having certain peculiarities of color or of action are not fitted for food, will they not rather continue to profit by such experience, and avoid such at whatever time of year and wherever they encountered them ? Besides, does all of this education have to be acquired by experience, or does heredity not exert an influence more or less important ?

The adult of the Hickory tree-borer, *Cyllene pictus*, develops chiefly in *Carya*, and emerges in spring, being almost exactly reproduced, so far as form and colour are concerned, in the Locust tree-borer, *Cyllene robiniæ*, which develops in *Robinia pseudacacia*, and emerges in late summer. Both of these species are supposed to mimic wasps, but we will suppose that both wasps and borer have disappeared before the latter species of borer has emerged; would it not gain some protection from its close resemblence to the borer that had preceded it, several months earlier ? Would entomologists be very much astounded if such conditions should be found to obtain among other species ?

Adults of our *Podosesia syringæ*, resemble, very closely, both of our common species of Polistes, *P. annularis* and *P. metricus*, especially on the wing, and when at rest the abdomen of the moth is bent downward posteriorly and kept in constant motion, precisely as with the Polistes. If the moth is on the ground it does not readily take flight, or, like many other moths remain quiet, but moves about in precisely the same manner as the wasps. In this case a defenceless moth is not only, in all probability, protectively colored, thereby resembling an entirely different insect, armed with a formidable weapon of defence, but its movements are equally like those of the armed species, so that it must gain protection thereby, to greater or less degree. But if one were to hunt for *Polistes*, he would hardly select for his collecting ground a lilac bush long since out of bloom. He would be far more likely to search for them on flowers, where he would seldom if ever find *Podosesia*

Do we not here have grounds for doubting the necessity for the mimicking and mimicked forms occurring together over the same area, and if so, how far may they not be separated, and the former gain more or less protection from its enemies? Is it not more probable that birds and other natural enemies will avoid species having a close resemblance to armed or distasteful species, during their entire life, and wherever they may go? Will not birds that have hatched and reached maturity in the north, and there learned to avoid armed or inedible species of insects, or such as closely resemble them continue to follow the same policy respecting the latter, after they have migrated far to the southward, and may not the recollections of *Polistes annularis* offer protection to species resembling it, like the *Podosesia syringæ*, for instance, far beyond the geographical distribution of the former species itself? Unless birds are continually forgetting and having to relearn past lessons, we must certainly admit that protective mimicry and protective coloration may be in effect, over the entire area of distribution of the species deceived, even though this extend far beyond the area occupied by either the mimicking or mimicked species, though, as a matter of course, this influence must decrease as the deceived species are displaced by those new and untried. It would certainly seem that we might here find a solution of some of the very many perplexing problems of form, movements and coloration, that are constantly confronting the student of animal life.

That at least birds and animals do not readily forget old habits and former experience, especially if the lesson has been emphasized by pain, I will give two illustrations, one borrowed, the other my own, and doubtless many others will readily occur to anyone who will take the trouble to recall them.

In his exceptionally valuable work, "The Naturalist in La Plata," all the more valuable because of the author studying life in living forms, and speaking only of what he observed, Mr. W. H. Hudson, informs us that in that treeless country some species of woodpeckers have, through necessity, acquired the habit of seeking their food on the ground, and even nesting in the banks of streams, yet where this change of enviroment and consequent alterations in their way of living, have, in some cases, resulted in structural modifications, thereby showing their antiquity, they still retain their primitive habit of clinging, vertically, to the trunks of trees (presumably introduced) though the habit has long since lost its use. We thus have evidence, not only of the permanency of established food habits, but that habits of this sort are transmitted through long periods of time through the influence of heredity.

Years ago, when sparsely settled and therefore in a nearly primitive condition, the prairies of Illinois, where the greater part of my childhood was passed, were inha snakes of various species. My father owned a pair of oxen, one of which had, when a calf, been bitten by a snake; an experience that he never forgot. So long as he was retained on the farm, he could seemingly not only detect the presence of these reptiles by sight, but if out of sight and near at hand he appeared to scent them as unerringly; and once he detected the presence of a snake, of any kind or dimensions, he would give a snort and with a deep bellow break for home, whether attached to plow, harrow or waggon. On one occasion, with my father, I was crossing a track of prairie in early spring. The dry grass of the previous year had been burned and the ashes had disappeared, leaving the surface bare and brown, as the young grass had not yet put forth. I, at the time a very small lad, was in the waggon, while my father walked along beside the oxen. Suddenly "Old Star" gave a snort, and with a bellow that seemed to frighten his mate also, started off on a mad run, taking a bee line for home, not stopping until their stable had been reached. After assuring himself of my safety, my father returned to the place where the oxen had started on their wild run, and near by found a group of snakes that he had not before observed, belonging to a harmless species, collected in a confused mass, as is their habit at this season, enjoying the warm rays of the early spring sun. It does not seem probable that the sting of an insect would have a less lasting effect on a smaller animal or bird, or the recollections of a particularly distasteful morsel in the mouth soon become extinct, and besides, my father's ox would probably not have acted differently, or any sooner forgotten the pain of the snake bite received on the prairies of Illinois, had he been transferred to New England or California.

Along the south shore of Lake Erie I find two species of Hemiptera,* *Salda ligata*, Say, and *S. interstitialis*, Say, the latter and smaller, when skipping nimbly about, as Mr. Say stated that it did on the shores of the Missouri River, have a deceptive resemblance to so many stranded *Hydrophorus*, which I believe prefers such places to sandy beaches; and along Lake Erie at least they are far outnumbered by this species of *Salda*, which so closely resembles them. *Salda ligata* is larger and does not resemble any of the aquatic beetles found along the lake, but simulates to a remarkable degree some of the species of *Bembidium*, though at the time of my observation it was impossible to find a single representative of this genus in that immediate locality, whereas, they were most surely to have been found along the shores of almost any stream. Now, these two species of Hemiptera not only closely resemble species of beetles not present, but inhabiting quite similar places elsewhere, but also the movements of one species of Hemiptera add much more to this deception than does its color, thus raising the question as to whether these peculiarities of color and movement are mere coincidences, and of no service to the possessors, or whether they do receive benefit from such simulations by taking advantage of the lessons learned by the sand piper, or other birds of similar habits, along the shores of some distant inland stream; and which lessons caused them to shun insects having these peculiarities of form, movement and color. Is the investigator justified in casting aside the whole problem, because he does not happen to look far enough to see all of the factors entering into it?

On the extreme tips of the new growth of pine, a tree not indigenous in the locality where these observations were made, I find during June and July, a *Capsid*, *Pilophorus amœnus*,† which while at rest has much the appearance of some species of the Coleopterous family, *Cerambycidæ*, no species, however, being at all common on this tree, in this locality, though *Euderces pini*, is said to occur elsewhere on the pine. While moving about among the pine needles, however, the Pilophorus has almost exactly the quick, active, erratic movements of ants which frequent the same situations in considerable numbers, the Capsid, except when at rest, being almost indistinguishable from them. If all of this deception was for the purpose of misleading the ants, it would seem as though it would have been carried further, and obtained while the Capsid was at rest. The tips of these pine twigs are practically inaccessible to even the smaller arboreal birds, and against these protection is here unnecessary, while except an occasional spider, invertbrate enemies are equally wanting. In fact, so far as the need for protection in this particular situation is concerned, the whole matter of protective mimicry would fall to the ground, as no protection appears necessary, yet, it seems to me, that the careful investigator would not be justified in dismissing the whole matter as a mere coincidence, but rather in searching elsewhere for the causes of a phenomenon of which the effects only are here perceivable. The polished surface of the abdomen of an ant reflects the rays of light in such a manner as to appear like a narrow band of white, of which the transverse white fascia on the wing covers of *Pilophorus amœnus*, when that insect is in motion, appears almost the exact counterpart. I have never observed *Euderces pini* in life, but it does not seem impossible that it too may move about in a similar way, and both together mimic the ant where protection is necessary, my observations being made where but two of the three actors are present, and no protection necessary.

Another diminutive Capsid, *Halticus bractatus*,‡ is found in Ohio, and among other plants affects Red Clover, *Trifolium pratense*, feeding in all stages upon the upper side of the leaves. The effect upon the plant is to discolor the leaves, but this really affords protection to the young, as the changed color more nearly harmonizes with that of their bodies. The adults are black with antennæ and legs, except the femora, yellow, the femora being also black, both sexes being saltatorial. The male has the normal form of an Hemipter, but the female differs entirely in appearance, and simulates to a remarkable degree, a beetle, *Chætocnema parcepunctata*, also very common on clover and other plants' Curiously enough, where I find the former in greatest abundance, there are almost none at all of the beetles, while in a clover field not over one-fourth of a mile away, the beetles are very abundant and none at all of *Halticus bractatus* That we have here a well defined case of simulation can hardly be doubted, yet the simulating form and the form simulated avoid each others company as if mortal enemies, there being no other forms present that at all resemble them.

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*Kindly determined for me at the Department of Agriculture.

†Kindly determined by Professor Herbert Osborn.

‡ Also determined by Prof. Osborn, who, with my assistant Mr. C. W. Mally, found the species quite abundant in Iowa, the latter gentleman observing it also in Northern Ohio.

I have made no experiments with any of these insects in order to determine whether or not they are distasteful, for the reason that any results obtained with the facilities at hand would have added to instead of reducing the complication. I might, like Professor Plateau, have eaten some of these insects, and learned whether or not they were distasteful to me, or I might have fed them to domestic fowls, or wild birds in confinement, but failed entirely of securing the data required. It seems to me that the only testimony in these matters, worthy of consideration, is to be found in the stomachs of insectivorous birds, and other vertebrate enemies if any, shot while feeding in the exact locality and under perfectly free and natural conditions. Giving a bird perfect freedom and allowing it to make its own selections and discoveries is one thing, while confining it, and doing these things for it, is quite another. It is what these natural enemies actually do, under perfectly natural conditions, that we must learn, and not what they can be induced to do.*

Over a large portion of the United States, and to a less extent in Canada, primitive conditions no longer obtain, while modern conditions are undergoing a constant change, the plow and axe of the husbandman having exterminated many forms, both vertebrate and invertebrate, if not entirely, over large tracts of country, and we may and probably do have cases of peculiar coloration and movements that were once protective, but now remain only as vestiges of a former state of affairs, the forces that brought them into existence no longer existing, except locally.

One phase in the radical changing of the natural flora and fauna over areas of greater or less extent, whereby both plants and insects are entirely displaced by others, emphatically different, is shown by the two accompanying illustrations, showing the bed of a small lake just prior to and after being brought under cultivation, and an aquatic insect fauna displayed by another, terrestrial, and more or less connected with the introduced flora. (See plate preceding, page 65).

In Northern Illinois a species of willow, *Salix discolor*, the leaves of which are nearly white on the under side, grows in wet places, on hummocks, and to the height of from one to six feet, forming a regular compact cluster. The foliage is fed upon by a hard, heavy bodied beetle, an inch or more in length, and often nearly a half inch across the shoulders, in color ebony black with white pubescence, which on the elytra is arranged in irregular transverse fasciæ, with more or less parallel markings, all of which combine to give the insect the appearance of a white surface, irregularly tessellated with black. This beetle, *Plectrodera scalator*, fig 82 feeds by eating holes in the leaves, or irregular notches, leaving the mid and lateral veins, with irregular borders of the leaf along these nearly intact. The beetle remains on the under side of the leaf, the eaten portions of which, against the background formed by the interior of the thicket, appear black, while the uneaten portions appear nearly white. In this way a beetle stationed on an uneaten leaf has almost the exact appearance of a leaf partly eaten, and so perfect is the deception that a fairly good collector may pass some years in a locality where the species is very common, without seeing a single specimen, until he detects the deception. Aside from its considerable dimensions and hard body, this beetle is armed with a rather formidable spine on each side of the thorax, thus rendering it rather an undesirable sort of prey for any of the smaller birds, and altogether too much so for any invertebrate enemies. In

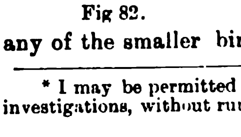

Fig 82.

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* I may be permitted to state that, in Ohio, birds cannot be shot for the purpose of making scientific investigations, without running the risk of being arrested and heavily fined therefor.

the locality in Illinois, where I studied this species, only two vertebrate enemies can be said to exist, one the Shunk, *Mephitis mephitica*, and an occasional entomologist, neither of which are at present abundant. Does it appear likely that all of this is brought about by mere accident, or is it not far more probable that protection was once gained, and elsewhere the deception may continue to give protection?

There are still other points in this problem that seem well worthy of careful consideration. We hear the terms, warning colors, protective mimicry and protective coloration, etc., used, as a rule, in the sense of a finality. Just as though these particular workshops of nature had finished their mission, and were now closed indefinitely; and while we have ample supplies of the finished product, there is none at all in process of construction. Have we here no transition stages? We are dealing with some of the forces that go to make what we term evolution, a process going on, as is believed, continually and everywhere about us, and if this is true might we not confidently look for species and varieties that are in the process of becoming protectively, or even warningly colored, or the condition which we term protective simulation not quite obtained? If perfect protection is never quite reached, does not this of itself presuppose progressiveness and, therefore, instability? May we not, in fact, in the future come to measure the antiquity of some of our species by the degree of perfection with which they are mimicked by others? It would probably necessitate remaining together through a long period of time in order to enable an unprotected, younger and therefore less stable form to gain protection from a distasteful form, especially as the advance in that direction must necessarily come from the weaker, unprotected and younger form. To illustrate, our *Danais archippus* is supposed to be a very old species, while *Limenitis disippus* is supposed to be a much younger species. What is true here would also obtain in the case of *Podosesia* and *Polistes*, thus indicating the greater antiquity of the latter, though probably belonging to a younger order than the former. Mr. Gahan has shown[*] that there is a remarkably close resemblance between seventeen species of *Diabrotica*, inhabiting Mexico and Central America, and an equal number of species of the genus *Lema* occurring in the same section of country Among the species of *Diabrotica* given, but one, *D. vittata*, is known to occur north of Mexico, and none of the species of *Lema* here sufficiently resemble any of the species of *Diabrotica* to lead to the suspicion of protective mimicry. In fact, it is only along the Mexican border that we have any striking resemblance between any of our species and those of the latter genus. In the states bordering on Mexico, Professor Wickham tells me that *Andrector 6-punctata* bears a striking resemblance to *Diabrotica 12 punctata*, and another species of *Andrector* is very much like *D. tricincta*. There is no positive proof that these are cases of protective mimicry, and Mr. Gahan does not claim this for the cases of close resemblance to which he calls attention, but in all of these there are certainly strong grounds for suspecting that such will ultimately prove to be the case. I have elsewhere shown[†] that there is every probability that the ancient home of the genus *Diabrotica* was in northern South America, many North American species originating in Central America and Mexico. It would seem, then, that *D vittata*, *D 12 punctata* and *D. tricincta*, having spread northward from Mexico, and being the oldest northern forms of the genus, might be mimicked in Mexico and the adjacent portion of the United States, because of having occurred there a sufficient length of time for such conditions to be brought about, while farther north they, with the rest of the genus, are comparatively recent comers, and sufficient time has not elapsed to develop cases of protective mimicry.

In conclusion, I desire that nothing in this paper shall be so construed as to, in the remotest degree, favor hasty or unwarranted conclusions in studies of warning colors, protective mimicry or protective coloration, but I do wish to urge that the same caution and painstaking labor should characterize our action in rejecting, finally, possible cases of these phenomena that would be exercised before accepting such, were the possibilities greater or amounting to probabilities, that we shall lean no more or less to the pessimistic than to the optimistic, but weigh every fragment of information, be it negative or affirmative, with equal care and discretion.

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[*] Trans. Ent. Soc. Lond. 1891. pp. 367-374.

[†] Jour. N.Y., Ent. Soc. Vol. III, pp. 158-166.

The points that I have tried to emphasize are:—(1) That a form of animal life may be distasteful to other forms, and so far as these are concerned, warningly colored; but neither the one or the other, where the form to be protected from is not a persistent and perpetual enemy, that, unrestrained, would threaten the extinction of the form preyed upon; (2) That a mimicking form may profit by a protective resemblance, not only where both it and the form mimicked occur together, but throughout the area of distribution of the deceived form, whether the mimicked form be present or not; (3) That a form, closely resembling in appearance a mimicking form, though occurring at a different time of year, or in a different locality, may profit to a greater or less degree by such resemblance, even though both mimicked and mimicking forms are absent, provided, however, the form protected from has somewhere come in contact with the distasteful form and learned by experience that it is inedible; (4) That we may and probably do have cases of partial deception, and, therefore, partial protection; (5) That cases of mimicry may occur where, owing to the fact of the enemies having become exterminated, or the mimicked and mimicking forms drifted into places inaccessible to such enemies, no protection is given or required; (6) That these problems are most far reaching, and we have as yet scarcely begun to study them in their entirety, hence the fragment hove over among the rubbish may yet prove to be the keystone of the archway through which we are to make our way into one of the grandest and most sublime of nature's many temples.

THE SAN JOSE SCALE.*

BY F. M. WEBSTER, WOOSTER, OHIO.

My topic is not of my own choosing, but the one assigned me by the Vice-President and also by the Secretary of the American Association of Nurserymen. I mention this fact, not in the way of compliment, but because so much has been said in public print regarding this pest during the last year or two, that I may not be able to present much that is new. About all that I shall attempt to do will be to bring together all the facts in our possession and point out to this association, for its consideration, some lessons that the past has taught us, and the possibility of profiting by such lessons in the future. To me, though not a nurseryman but one whose business it is to protect some of their interests, the introduction of the San José scale into the country lying to the east of the one hundredth meridian, and its suppression, so far as this has been accomplished, has meant something more than the mere study and investigation of the pest; more even than the overcoming of it and preventing its further diffusion. It has appeared to me as though, in the last half of the last decade of the nineteenth century, there had been presented to our people a test case, as it were, as well as a reminder that the coming twentieth century would bring to us problems which we had not previously been called upon to solve. The question that seemed to me to be involved was this: Can a republican government, composed of nearly half a hundred minor governments, protect its people from the ravages of a diminutive insect pest that has been introduced among them to devastate their orchards and fruit farms? What will be done under such circumstances, and who will be the ones to do it? This scale is a serious pest, but is it not, besides this, the straw that denotes the direction toward which the wind is blowing? We have but to cast our eyes toward the State of Massachusetts where a fierce battle is being carried on against another imported pest of our orchards nd forests, solely by one member of this republic, while the others are simply spectators ooking on with a disinterestedness that amounts almost, if not quite, to a total indiffernce. These are the two at present, most important introductions of foreign insect pests, ut no one can for a moment suppose that others will not follow, coming as with the an José scale, from we know not where. You, gentlemen, are engaged in a business hat necessitates the exchange of scions, grafts, trees and shrubs, but may also be dissemnators of these pests not alone to your customers, but to each other. And, whether you ill or no, you cannot escape being foremost in the settlement of a problem that half a entury ago was unthought of. Hence, while I address you on the subject of the San José cale, it will be to view it as a factor in what seems to me to be a great and difficult problem n the future of your business; and with this explanation I will proceed to consider that actor.

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* This valuable paper, read at the Twentieth Annual Meeting of the American Association of Nurserymen, at Indianapolis, Ind., June 12th and 13th, 1895, has been kindly furnished us by the writer, and will be found well worthy of perusal in view of the fact that this insect may at any time be found in Ontario. —ED.

The San José scale was first observed in this country in the locality in California from hich it derives its name, coming from we know not where, but probably from either ome of the islands of the Pacific or else some of the Asiatic countries beyond. This ntroduction is thought to have taken place about the year 1870, and began to attract he attention of fruit growers about three years later, but so far as known only in the ocality above indicated. In 1880 Prof. J. H. Comstock described the species, and rote as follows: "It is said to infest all the deciduous fruits grown in California, xcepting the peach, apricot, and black Tartarian cherry. It attacks the bark of the mbs as well as the leaves and fruit. I have seen many plum and apple trees upon which he fruit was so badly infested that it was unmarketable. In other instances I have seen he bark of all the small limbs completely covered by the scales. I think it is the most ernicious scale insect known in this country." For the reason here given, Prof. Comstock ave it the name of *Aspidiotus perniciosus*, and I may here add that it has since been ound to occur on both the peach and apricot, and fully merits the name given it by the escriber. It appears to have spread quite rapidly, for in 1882, nine years later, it had xtended over all of the fruit growing regions of California and across Oregon into Washington. As late as 1893, the Los Angeles Horticultural Commission, in their report or that year, stated that the pest, if not speedily destroyed, would utterly ruin the eciduous fruit interests of the Pacific coast; that it not only checks the growth of the rees, but covers them literally entirely, and the fruit nearly as much so, and, if left nchecked, the tree is killed within three years' time. This will serve to show you the erious nature of this little pest, as demonstrated by its twenty-five years' residence on he Pacific coast.

I will occupy a few moments here to consider its probable origin, though, as before tated, we do not as yet know the land of its nativity. It is found in Chili, but was learly introduced to that country from California. It also is found in Hawaian Islands, aving been introduced from California on prune and peach trees, and also in Australia. ut nowhere in these countries has it been found inhabiting indigenous vegetation, which e entomologists claim, must be done in order to prove the nativity of the pest. Quite ecently, Professor Cook has sent it from California on the Loquat, *Photinia japonica*, nd, as will be observed, there are several of our forest trees included in Dr. Lintner's st, but this proves nothing as it would be surprising if, in its twenty-five years' residence n this country, it had not begun to adapt itself to our native flora, precisely as some of ur native parasitic insects are beginning to learn that they can add it to their bill of fare. onsiderable of the nursery stock required in California is grown on some of the smaller slands of the Pacific, as for instance, Tahiti, and it seems at least possible that we may n this way have acquired a pest that may be an inhabitant of an obscure island, and, for ught we know, it may be so inconspicuous there as to require the trained eye of the aturalist to detect it.

The insect itself, Fig. 83, belongs to a group known as armored scale insects, their earest allies being the Oyster-shell Bark-louse, while still farther removed are the ealy-bugs. We have here in the east a somewhat similar species that I have found on each, plum, pear and maple. This is known as the Putnam scale, *Aspidiotus ancylus*, having been first described by the late J. Duncan Putnam, from Iowa. It is known to occur on the following plants also, ash, beech, bladder-nut, hackberry, linden, oak, osage-orange and water locust. This is often mistaken for the San José scale, even by those who are quite familiar with the latter. My own manner of distinguishing between these two scales is to first observe if the disc is circularly wrinkled and the elevation in the centre surrounded by a depressed ring; if the scale is very flat, or if it appears to rise gradually from the outer edge to the base of the elevation; if the scales are disposed to crowd in compact patches. If the disc is circularly wrinkled with a deeper ring about the base of the elevation; if the scales crowd each other closely and give the tree a gray

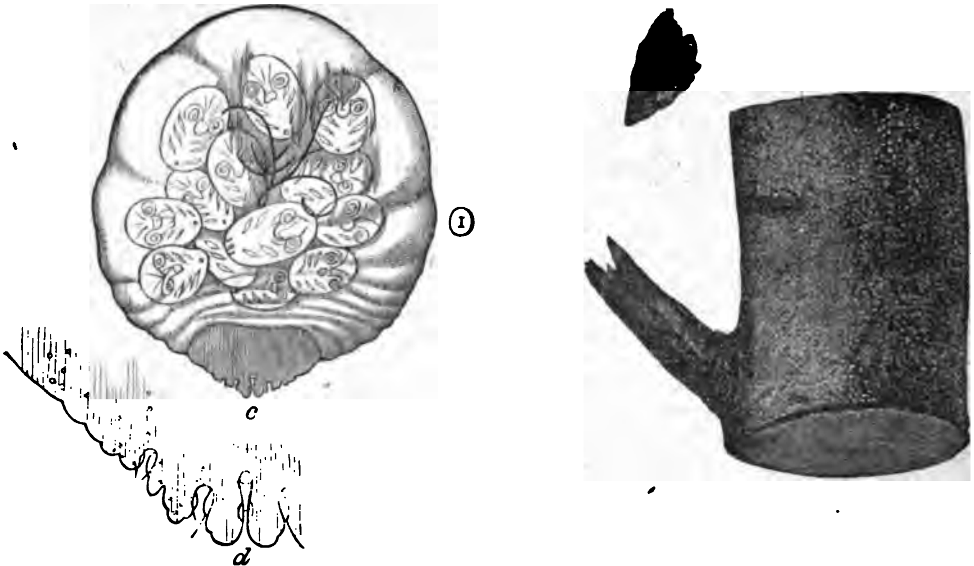

Fig. 83.—San José Scale, female enlarged and part of infested branch (life size.)

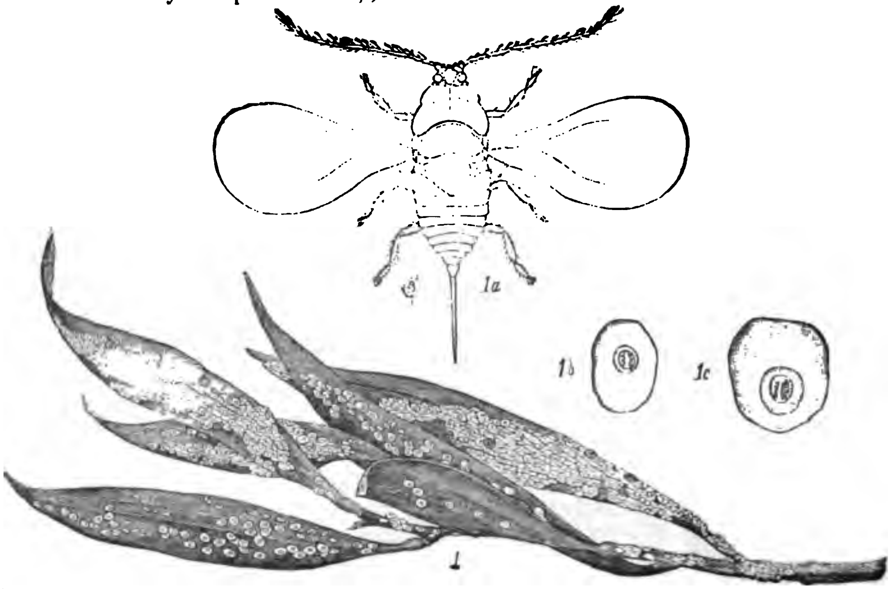

Fig. 84.

appearance, it is the San Jose scale. If the disc is smooth, and the central point rises out of a smooth area, it is probably the Putnam scale. Another scale that has come to me several times as the San Jose scale, is the Oleander scale, *Aspidiotus nerii*, Fig. 83, which also attacks ivy. But this is of a lighter color, flatter and longer.

The Rose scale, *Diaspis rosæ*, has been sent me, both on the rose and raspberry, with the query as to whether or not it was the San José scale. But this is also larger, more depressed and of a lighter color. In short, we have nothing that clusters so thickly together on the host plant, and gives it that peculiar gray color, which once seen will never be mistaken for anything else.

In regard to the life history of the species now under consideration, it appears to differ from that of many of our scale insects in that instead of reproducing by laying eggs, the mother gives birth to her young. As by far the most careful studies made on this species have been carried on at the Department of Agriculture, under the direction of U. S. Entomologist, Dr. L. O. Howard, I take the liberty of giving Mr. Howard's statement in his own words. He says: "Although this insect has been known in California for about twenty years, its life-history has not been carefully worked out by California writers Professor Comstock described simply the male and female scales and the body of the adult female. The male was unknown to him. In his work on the Injurious Insects of the Orchard, Vineyard, etc., published at Sacramento in 1883, Mr. Matthew Cooke briefly described the male insect and published a crude figure of it He further stated that the species produces three broods in California, the first "about the time the cherries begin to color, the second in July, and the third in October." The statement is made by Comstock that the eggs are white," and Cooke further says that "each female produces from thirty-five to fifty eggs."

"Upon the appearance of the insect in the east, potted pear trees were secured for the Insectary of this division, and colonies of the scale were established on them. Their life-history has been followed with more or less care throughout the season, and the following brief statement of the life cycle of the insect is based upon daily observations made during the summer by Mr. Pergande.

"It has already been ascertained during the late summer and fall of 1893 that the insect is viviparous, that is, gives birth to living young, and that it does not lay eggs. We are unable to reconcile this condition of affairs with the statements just quoted from Comstock and Cooke, but it occurred to us that, as with certain of the plant-lice, there might be winter eggs, with viviparous females in summer. When winter came on, however, it was found that the insect hibernated in the nearly full grown female condition, and that these females, about the middle of May, began to give birth to living young as their ancestors did the previous fall. In no instance, therefore, have we observed the egg (unless the young still in the body of the female and enveloped in the embryonic membrane may be so called). Over-wintered females continued to give birth to living young day after day for six weeks. This condition of affairs produces, early in the season, a confusion of generations, which makes observations upon the life-history of the insect extremely difficult and only to be accomplished by isolation of individuals. It also seriously complicates the matter of remedies, since, as numbers of the larvæ are hatching every day, and as they begin to form their almost impervious scales in two or three days, a spraying operation at any given time will destroy only those larvæ which happen to be at that time less than three days old, while on the day after the spraying new larvæ will be born to take the place of those just killed.

"Observations upon isolated individuals show that the newly hatched larvæ, after crawling about for a few hours, settle down and commence at once to form a scale. The secretion is white and fibrous. In two days the insect becomes invisible, being covered by a pale, grayish-yellow shield, with a projecting nipple at the centre. This nipple is at first white in color. Twelve days after hatching, the first skin is cast. The males at this time are rather larger than the females, and have large purple eyes, while the females have lost their eyes entirely. The legs and antennæ have disappeared in both cases. Six days later the males begin to change to pupæ, while the females have not yet cast the second skin. At this time the females are so tightly cemented to the scale that they cannot be moved without crushing. In two or three days more, or twenty to twenty-one days after hatching, the females cast their second skin, which splits around the margin of the body. At twenty-four days the males begin to issue, emerging from their scales, as a general thing at night. At thirty days the females are about full grown, and embryonic young can be seen within their bodies; and at from thirty-three to forty days the larvæ begin to make their appearance.

"These observations were made upon young which were born of over-wintered mothers late in June; but it must be remembered that similar larvæ had been hatching since the middle of May. The period of thirty-eight to forty days may be accepted as the length of time occupied by a single generation; but, while this particular generation came out in the insectary about the 1st of August, the adults of the second generation from the earliest born individuals would have made their appearance toward the end of June. Full grown females which began to give birth to the second generation of young on August 1 were kept in view. Three weeks later they were seen still to contain numerous embryos. Young larvæ were running about, while others of the same generation were in all stages of development. The male scales were fully formed, and some contained mature pupæ. The small trees upon which these insects were colonized the third week in June were almost completely covered with the scale. The larvæ evidently made no effort to crawl away from the tree, and none, in fact, reached the rim of the flower pot. The greatest distance away from the tree at which larvæ were noticed was about two inches. Up to this time the insects had confined themselves almost entirely to the branches, and the leaves were still quite free. The first males of the second generation were noticed on August 27. By September 7, or five weeks and a half after the adult females of the first brood began to give birth to young, some of them were still living and giving birth to occasional young. The majority of them, however, were dead or nearly exhausted, while their first larvæ were almost ready to reproduce. Five days later, a few of them were still giving birth to an occasional young, while their offspring were also rapidly reproducing.

"At the rate of development observed, between May 15 and October 15 four generations from the over-wintered females developed. The larvae continued to issue until after the first frost in October, at Washington, and on October 24, at Lewisburg, Pa., the writer saw recently-settled larvæ of not more than five days of age.

"There seem to be five generations in the latitude of Washington. Owing to the method of reproduction, these generations immediately become inextricably confused, and the insect after the middle of June may be found at any time in almost any condition. The females which over-winter have, in the great majority of cases, reached a sufficient degree of maturity to have become impregnated by late-issuing males. It seems probable that the male rarely hibernates in any stage, although we received on April 3, from Charlottesville, Va., twigs which carried a few male scales containing males in the pupa state. These probably hibernated as full grown male larvæ. Whether unfertilized females over-winter we are not certain; if they do, these occasional over-wintering males will fertilize them.

"The San José scale differs from all others in the peculiar reddening effect which it produces upon the skin of the fruit and of tender twigs. This very characteristic feature of the insect's work renders it easy to distinguish. Around the margin of each female scale is a circular band of this reddish discoloration, and the cambium layer of a young twig where the scales are massed together frequently becomes deep red or purplish. Small spots on fruit produced by a common fungus *Entomosporium maculatum*, Lev., sometimes so closely resemble the spots made by the scale as to require close examination with a lens. When occurring in winter upon the bark of a twig in large numbers, the scales lie close together, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened, scurfy deposit. The rich natural reddish color of the twigs of peach and apple is quite obscured when these trees are thickly infested, and they have then every appear-ce of being thickly coated with lime or ashes. Even without a magnifying glass, how- er, their presence can be readily noted if the twig be scraped with the finger nail, when yellowish, oily, liquid will appear, resulting from the crushing of the bodies of the sects."

The female scale is flat, almost circular in outline, dark mottled with gray color, with small elevated spot at or near its centre which is black or yellowish; it measures about e sixteenth of an inch in diameter, but under favorable conditions may attain to the size one-eighth of an inch The fully developed female can only be observed by removing e scale with which it is covered at a time when she is just about to give birth to her ung. She will have then lost both her legs and antennæ, being now only provided with long delicate proboscis consisting of four thread-like bristles encased in a two jointed eath. The body is almost transparent, and the young can be clearly distinguished within.

The male scale is black and somewhat elongated when fully formed. It is often oval shape, smaller than the female, and more abundant. The larval skin is covered with a cretion, and its position is indicated by a single nipple-like elevation between the centre d anterior margin of the scale. The fully developed male only has wings. The body of a light amber color with dark brownish markings, and terminates in a slender stylet long as the body. It is, however, too minute to be of interest to any but natu- lists, having to be always examined with a microscope.

Such was the pest that was, as we supposed, lurking only along the Pacific coast, ith a vast width of mountain and desert lying between it and the fair lands and thrifty chards of the Mississippi valley and beyond. We did not for a moment dream that the st had gained a foothold along our eastern coast as well, and was each year being sent to the heart of our land, and even the entomologists were in blissful ignorance of its esence. In 1892, Professor Townsend had reported it at Las Cruces, New Mexico, but at was almost as far off and isolated as California, and we still slept on in our supposed curity. Early in August, 1893, there came to the Division of Entomology at the De- rtment of Agriculture at Washington, a small bundle of pear and peach twigs from harlottesville, Va., the sight of which fairly raised the First Assistant Entomologist, ho examined them, out of his chair, for he at once recognized the San José scale. But en yet it was thought to be only an accidental occurrence. Later investigations of an- her outbreak indicated that the pest had come from a prominent nursery in New Jer- y, and on being inspected the insect was found to have become thoroughly established d probably had been for several years, as the trees whereby the insect had been traced this nursery had been sent out in 1888. I shall here follow a policy that has always peared to me to be the only just one for an entomologist to follow, and give the name the nursery, which is that of Mr. John R. Parry, of Parry, New Jersey. This was the st intimation that this firm had of the seriousness of a pest that they failed to recognize, ough on referring to their books they found that in 1887 they had ordered from John ck, of San José, California, a quantity of Kelsey's Japan plum trees, and that these trees d been shipped by Mr. Rock's order from the nursery of the Stark Brothers, of Louis- na, Missouri.*

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*Mr. Stark, of this firm, made the following explanation at the close of the reading of the paper:—

As Prof. Webster mentions our name, we wish to state the circumstances in full as we now recall em: In 1885, we had the pleasure of visiting the nursery of John Rock, at San José, California. Mr. ck is well known as one of the principal California nurserymen, and it is needless to say that the visit s interesting, and instructive as well. Among other things particularly noted, was his method of treat- trees before shipment to destroy the San José scale. This method he supposed to be entirely effective, d, remembering this, in the spring of '87, the Kelsey plum being then a scarce novelty, we ordered a lot first-class Kelsey plum trees from Mr. Rock; but as a good many of us have learned "first-class" trees the Pacific coast mean a very different thing from first-class trees in the east. On the coast, it seems y sometimes go into rows of one year trees and dig about everything clean that is thrifty and two or ee feet in height, or even less; so when the trees arrived and the lid was removed from the box, show- one year trees running from about eighteen inches in height upwards, it was apparent we could not ep nor use the grade and we so wired Mr. Rock, who wired in reply to express them to the New Jersey rties, and the trees accordingly were immediately expressed to Messrs. Parry and to J. T. Lovett, thus ckly removing every one of these Kelsey trees from our grounds—a most fortunate circumstance for us, it has since appeared.

The Parry people were as much astounded at the revelation as were the Government Entomologists, and promptly destroyed over $1,000 worth of stock, and as promptly stopped shipping anything from their nursery, buying from localities that are even now beyond the area of infection, the trees whereby to fill their orders. From this time on this firm has followed this policy and bent their whole efforts on stamping out the pest on their premises, sparing no expense in the accomplishment of their purpose. I cannot myself find words to express my own commendation of the course of this firm, and I do not believe that the American people will overlook or underestimate the public spirited acts of the Messrs. Parry Had all of those who are engaged in your vocation, and were similiarly unfortunate, followed this course, the entomologist and the agricultural press might have been spared the unenviable task of exposing their disgrace. The introduction of the San José scale from California was a sad piece of carelessness on the part of at least four firms of nurserymen, as either one, had they applied to the Department of Agriculture, might have learned and avoided the danger, as the Division of Entomology had, at the time the introduction took place, two of its special field agents in California, and would most certainly have pointed out the danger had an opportunity been presented. Up to the time that the proprietors were notified of the presence of the pest, then, carelessness only can be charged against them, and they should be judged according to their acts since that time. The Parry Brothers, when the pest was found established on their premises, asked that the fact be withheld from publication, as it would otherwise ruin their business. Considering the efforts being made by them, it was certainly no more than just to give them an opportunity to show what they could and would do, and as we yet have no reason to suspect that they have betrayed the confidence placed in them by the Government and State Entomologists, and, besides, they have willingly furnished entomologists with a list of purchasers who were liable to have received the pest with trees sold from their nursery, prior to this discovery of its presence among their nursery stock. What more could they have done to undo the wrong, or prevent its continuation?

Soon after the foregoing outbreaks of this pest had been investigated, another badly infested nursery was located in New Jersey, that of the Lovett Company, at Little Silver, and which, as we now know, was infected in precisely the same way and at the same time as the first. This nursery was known to be infested as early as September, 1894, when it was visited by the entomologist of the Experiment Station of that State, and the fact pointed out to the officers of the company, who promised to destroy and disinfect their trees before sending them out to their customers. The New Jersey entomologist took upon himself the responsibility of stating in public print that these precautions were being taken, and that everything possible was being done by the company, whose name he did not give, probably supposing that he was dealing with men who would readily see that their own interest would lead to such a course, and was not as active in holding them to their promise as he would have been justified in doing. It was late in December—over three months later—that I received twigs of apple infested by this scale from Clermont county, Ohio, and on promptly visiting the orchard found some twenty-five trees literally covered with the pest, and three times as many more infested to a large degree, but all in such a condition that sixty of them have since been dug up and burned. These trees had been purchased from the Lovett Company and planted out in spring of 1890. In a note given to the daily press on the discovery of this serious outbreak, I stated the fact that the trees had been purchased from this firm, but did not accuse them of having, at that time, the scale among their trees, though the fact was not unknown to me Promptly on the appearance of my note came a letter to the Director of the Ohio Experiment Station, which ran as follows:

LITTLE SILVER, N.J., December 28, 1894.

Director Experiment Station, Columbus, Ohio:

DEAR SIR,—One of our customers has sent us a clipping from a Columbus paper, in which is stated that trees owned by one Mr Nicolis have been found infested with the San José scale. You will please give us all the information you can in regard to this matter. We would like very much, indeed, to have some branches from the trees referred to for examination ourselves. We have made a critical examination of our trees here in the nursery and also fruiting trees, using the miscroscope, and can find no trace whatever upon any of them of the San José or other scale. Having read reports upon the San José scale, we are confident that we could detect this insect if it existed upon our trees.

Yours truly,

(Signed) THE LOVETT COMPANY. H.

Now here was a serious state of affairs indeed. An official entomologist, whom I had known for years, had given the information, and here was a firm assuming their innocence, and being compelled to go over a whole nursery with a microscope, in fruitless search after the San José scale. Gentlemen, did any of you ever attempt to go over a tree with a microscope? And do you remember how much time it required to accomplish the task; how tiresome it was and how weary you were long before you had finished? Yet here were men compelled to go over a whole nursery, because of an unjust accusation. I promptly sent a copy of the letter of the Lovett people to the New Jersey Experiment Station and asked them to explain the matter. They were able to explain everything except the conduct of the firm, but at that were as much astounded as I was, and again reiterated the statement in regard to the examination with the President and Secretary of the company the preceding September. A month later, in February of the present year, Dr. Lintner, State Entomologist of New York, asked them to furnish a list of their sales in his State—such as had been freely and gladly done by the Parry Brothers—explaining at the time its character and the value it would possess in undoing the wrong that they had unintentionally done. After much delay and dickering, the Entomologist of the New Jersey Station received the following modest proposition: "If he (Prof. Lintner) will send us, or you either, a remittance of $250, we will attempt to make the examination desired. But we want a clear understanding before we begin as to the settlement of cost of sending the list he requires." I need hardly say that the money was never sent for there is little doubt but that the list would have been as "scaley" as their trees. Public indignation, however, had been rapidly increasing, and on February 22nd, the Entomologist of the Experiment Station accompanied by a member of the editorial staff of the Rural New Yorker, paid this nursery a visit of investigation, and found that while some more or less effective means had been employed to destroy the scale, there was ample evidence of a carelessness that in many countries would have been considered criminal and cost the firm their plant, if, indeed, imprisonment were not added. I can only repeat here what I said of the action of the first-mentioned firm: it will be a long time before the people will forget these things, and all statements of the Lovett Company will be taken on probation, which probation will, if I mistake not, be a protracted one.

Even while the foregoing developments were proceeding, we became aware that there was another locality of distribution of this pest; viz., Long Island, N.Y.; and it was toward this part of his State that Dr. J. A. Lintner, State Entomologist, turned his attention, with the hope of protecting his people from having the scale distributed among their orchards and farms by Long Island nurserymen.

Dr. Lintner was only faithfully carrying out the duties of his office, and went about doing that duty in a moderate, conscientious manner, that ought to have received the unqualified support of every fruit grower and nurseryman in his State. But he soon found that he had the same diversity of character to deal with as had been revealed in New Jersey. Of the nine nurseries located on the island, but three were found to have become infested, and these, as given in a recent bulletin from the New York State Museum (Vol. 3, No. 13) are owned and operated by Fred. Boulon, Sea Cliff; Keene & Foulk, Bloodgood Nursery, Flushing; and Parsons & Son, also of Flushing. The first named, though moving in a somewhat dilatory way, finally destroyed his worst infested trees and sprayed so that it is hoped that no infested stock will be distributed. Of the actions taken by the second named firm, Dr. Lintner, in his bulletin above referred to, speaks in terms of highest praise. As soon as this firm learned of the presence of the scale on their premises they promptly burned the worst infested trees and sprayed the remainder, besides asking for instructions and directions in regard to methods of suppression, they have promptly carried out every one of these, making every effort possible to protect their customers, offering on request to replace at half price all trees sold from their nursery, during previous years, that were found infested by the San José scale. There seems to be no reason why this firm should not continue to enjoy the confidence and patronage of the public. The last firm mentioned, Messrs Parsons & Sons, chose an opposite course, and I may add, deserve opposite treatment. From the first, this firm paid no attention whatever to the evil, when it was pointed out to them, and when asked to disinfect their stock before shipping it to their customers, stated that they would if they had time; and, later, said they did not have time. There is very strong evidence in the hands of entomologists going to show that this firm made both their last fall and spring shipments, knowing that they were unloading their scale infested trees on the public and scattering this pest, the serious nature of which they could not help knowing, far and wide over the country. Failing in every attempt to secure satisfactory replies to his communications, or even a list of the patrons who were likely to suffer from their impositions, and after your humble servant had pointed out to him that he was only being imposed upon and his moderation toward this firm only being used to further their scheme of unloading their infested trees on the unsuspecting public, that he was forced to call upon the "Rural New Yorker" to expose them. In the issue of that publication for May 4, 1895, the editors, after exposing the Parsons Company, say that the Company made a plea of ignorance of the serious nature of the pest, and supposed it was only one of the many scales that they had known for the last fifty years. No wonder that the "Rural New Yorker" people were boiling over with indignation over a course that was alike unprincipled and un-American, and ask why it was necessary for them to come forward and make business men attend to their duty, telling the company that it was no excuse at all for them to plead ignorance of the dangerous character of the pest and neglect the repeated warnings that have been given. To plead ignorance was a direct insult to State Entomologist Lintner, who had again and again warned them of it and urged them to take immediate steps to prevent distributing it all over the country. These people now, after being publicly exposed, promise to do all in their power to prevent sending out infested stock, and if the public deal with them as they deserve, it will be some time before they will distribute their trees at all, for who will expect them to keep any promise after such evasions as they have attempted? If the entomologists and the press are not again called upon to expose them a second time, it will be a pleasant surprise.

Now, gentlemen, I have criticised harshly, but I sincerely believe not unjustly. I have exposed these people before you, not in order to taunt you with the disgrace of some who follow your calling, but because they threaten interests of yours that I am employed to protect. It is my business and duty to do so. You do not need to deal with these people yourselves to suffer contamination. Let me explain, and this I will do by illustration. Last winter a man came to me in high dudgeon and wanted me to show up a prominent firm of nurserymen in Ohio. He said that he had gone to them in the fall to buy trees. He did not appear to care much what the trees were so long as they were fruit trees and cheap. He said that he had gone to this nursery and found what he thought would answer his purpose, provided the price was right. The trees were poor and expected the price to correspond, "but do you believe," he said, "them galoots wouldn't sell me them trees at any price and said they were going to burn them up, I suppose just to make me pay a big price for others. But I won't do it. I'll buy where I can get what I want and at a reasonable price of eastern nurseries." Now, we all know what sort of a fruit grower such a man would make. One of the sort that sets out his trees and then lets the pigs, cattle, sheep and horses take care of them, and who, if he were to buy scale-infested trees would not find it out until the whole neighborhood was endangered. Suppose such a man buys scale-infested trees and plants them out in your neighborhood, thereby threatening your business, what will you do about it? If he furnishes scale enough to destroy a thousand dollars worth of your stock and ruin your trade for several years, you cannot help yourselves, in the present condition of our laws. You cannot reach the man who sold the trees, and to destroy them on your neighbor's premises without his permission, is to criminate yourself. I have no fears of the pushing, up-to-date fruit grower or the honorable nurseryman, for if they have the misfortune to get this pest, they will stamp it out without compulsion. But I am afraid of the nurseryman who will knowingly or carelessly distribute this pest to careless or indifferent purchasers; and this is precisely where we entomologists are expected to protect you. In order to protect the people of Ohio, I have felt from the start that it was necessary to first prevent this pest being continually shipped in from infested nurseries, and then use every means to find out infested localities and stamp it out. This is the only way that I can protect the people of my State, both nurserymen and fruit-growers. What is true of Ohio is true in other States, and of other entomologists.

It seems to me that what we need is a United States law, that shall apply equally well in every State in the Union, that will enable those nurserymen who wish to do so, to send their authorized agents into any State to do business, each firm being thus responsible for the acts of their agents. If nurseries desire to sell stock in States other than their own, or the people desire to purchase such stock, they should have legal protection. Then let every nurseryman be obliged to warrant his stock free, from insect or fungus pests before transportation companies can accept the same for shipments. This will do away both with the disreputable nurseryman and the tree-peddler, and place your business in the hands of honorable men. You may think it an objection, and possibly a hardship to thus be obliged to guarantee your stock free from these pests, but I fully believe it is precisely what you are coming to and of your own accord. I am fully convinced that within the next ten years every reputable nurseryman will spray his nursery stock several times each year with both insecticides and fungicides, not because he is obliged by law to do so, but because it will pay him well for the extra time and expense. We are beginning to learn that the apple scab begins to weaken the vitality of a tree from the first year onward, and the same is true to some extent with insect pests, that by spraying the nursery rows you can produce a greater number of first class trees to the acre, and so derive a larger profit from your land and the labor bestowed upon it. Now, this is only a suggestion whereby this problem of distributing such pests as the one under consideration can be prevented, at little or no real expense, and those more competent than myself can no doubt improve on the suggestion, and you will readily see that when another case like this comes up, and a nursery is found to be infested the owner has only to purchase his stock for a year or so of his more fortunate neighbor, until he can cleanse his premises and use his product. This will also do away with an injustice that I have seen all along, and, in fact, been obliged to, myself, make use of. I stated at the beginning of this paper that it was but right to give a reputable firm time in which to show what they would do to protect their customers, but it is a rank injustice to others of his profession to publish the fact of the occurrence of such a pest as this in a certain locality or State, and not give names in connection with such information. I am bitterly opposed to the policy that I have been obliged to follow during the last year, knowing, as everyone must, that to quarantine against areas instead of individuals, must work an injustice upon the very ones that are the most deserving of justice. When the word goes forth that this pest is in a certain State and liable to be distributed from it to others, the only protection for the others is to stop all shipments from the whole State, when there may be but a single nursery infested. This is the rankest kind of injustice, and I hope some measures will be devised to prevent a recurrence of such a condition of affairs as we have had with regard to the suppression of the San José scale. I have been obliged to warn the people of Ohio against New Jersey and Long Island, when I knew it was a wrong to the very men that I was trying to help, simply because I could not get the names of the guilty ones, and indicate them to our people. I hope, gentlemen, before you adjourn from your deliberations, you will take some action not only denouncing the course taken by the two nursery firms that I have named, but indicating some policy whereby this problem can be met in a judicious and at the same time thoroughly efficient manner. The San José scale is the latest importation, so far as we know, but it is not at all likely to be the last. Our commercial relations with other countries are not only increasing rapidly and broadening, but the time required for transporting your goods from place to place has been diminishing much more rapidly. It is now possible to remove plants from their native homes in Australia, South Africa, Europe or Asia, and in the short space of a month's time scatter them over the whole country. Destructive insects may thus go into their dormant stage in one country and emerge in another without having been disturbed or discommoded, something that would have been impossible twenty-five years ago. With such strides, such progress in these factors in your business, it will be absolutely necessary for you to bring your business methods up to date, and change to meet your changed conditions. By necessity, you are foremost in the diffusion of these pests of your trees and plants, and it would appear to naturally follow that you should be foremost in taking steps to prevent this diffusion—should lead instead of follow—and I hope you may begin to recognize the situation, and with past experience to guide you, look into the future and prepare to meet these emergencies and overcome them.

Returning for a moment to the San José scale, before closing, I will say that the insect does not appear to spread rapidly, at least not at the start, and is not so difficult to overcome, if given prompt and careful attention. At present it would seem as though it might be wholly eradicated from the orchard or nursery within a year after being discovered. Whale-oil soap, one pound to each gallon of water, makes a wash that is most fatal in its effects, when applied during autumn and again just before the buds start in the spring, followed by a similar treatment in autumn. The use of hydro-cyanic acid gas is thoroughly effective, and though rather expensive to use in an orchard, is not so much so where trees can be treated in bundles. Full instructions for using this may be had on application to the United States Department of Agriculture at Washington. It is true that this scale is now established at several points in most of the States east of the Mississippi river, but I am satisfied that all such can be stamped out, provided proper attention is given the matter now while it is yet confined to the orchards into which it was originally introduced. For the present this is the only protection that the nurseryman and orchardist have against this pest, or rather, I might say, against a disreputable fellow of his calling, or a shiftless neighbor; and I would caution you all to keep close watch of orchards in your respective neighborhoods, especially such as have been planted out within the last five years with other than home-grown trees. I find that in some quarters there is a disinclination to let the matter of infection become known. So far as the farmer and orchardist is concerned this is folly, as to have acquired this pest is no disgrace, but a misfortune, and I find that the statement that it has been discovered in a certain locality and promptly eradicated, is an incentive for others to look more closely to their trees and, in case the scale is found, follow the example of their neighbors.

In closing, I wish to call the attention of nurserymen to the fact that the entomologist is working for their interests, both in the matter of protecting them from getting such pests established in their nurseries, and aiding them to get rid of them in case they have been unfortunate enough to have done this. To prevent sending out infested trees from any nursery is a part of the duty of an entomologist, however disagreeable it may be to do so. So long as men are human, it will be necessary to resort to disagreeable methods of preventing them from wronging each other, and the best that can be done is to deal with strict justice toward all.

At the conclusion of Prof. Webster's paper, the following appreciative motion was put to the meeting and carried unanimously:

Col. WATROUS: "I think that the paper that comes out and deals with our interests as fairly and as wisely and intelligently as this one deserves a vote of thanks, and I move that a vote of thanks of this Association be tendered Prof. Webster for his paper and that we approve his course."

The CHAIR: If any of you have any questions to ask of Prof. Webster, he will be happy to answer them; or if any of you have any statements to make we shall be glad to hear them. It is certainly the most interesting subject that could come up in a convention, for it is a matter of dollars and cents for us.

Col. WATROUS asked what would be the proper course to pursue should a nurseryman be so unfortunate as to receive a bundle of trees from another nurseryman which were found to be infested by this pernicious insect.

Prof. WEBSTER: Send them back to the original nursery.

Col. **Watrous** inquired further if there were any way by which the insects could be killed on imported stock so that it would be safe to plant the trees and propagate from them. I want to know if it is absolutely necessary that they be burned or reshipped.

Prof. **Webster**: They could be disinfected by using hydrocyanic acid gas, the management of which you can get by applying to the Department of Agriculture at Washington. It is a very expensive treatment.* One receiving infested stock, if he did not send them back, could hold the trees at the order of the shipper. I do not see that the nurseryman should be called upon to take them at all or to take the responsibility and expense of disinfecting them.

Mr. **Jewett** asked what had been done in California. I have heard that they have exterminated it in some localities.

Prof. **Webster**: They have practically exterminated it in some localities; but they seem to have handled it very carelessly, and it may be said to cover the whole state more or less. They have used the lime, salt and sulphur wash. This has not been fully effective, and further than that we have found in the East that a treatment of great value in California is not so here. They have a resin wash there which it is claimed is fatal. With us it will not kill twenty-five per cent.

A **Member** asked if there was danger of the San José Scale spreading rapidly unless infested trees were taken up.

Prof. **Webster**: It is not the travelling of the insect itself, the spread in that way is not rapid; but it may be carried by the wind or by the young insects crawling on to birds which frequent the trees and being by them carried to other trees—so that it is dangerous to have it anywhere. It does not spread very rapidly, and if carefully sprayed it can be controlled and even stamped out. There are four or five places where I know it has been stamped out in Ohio. I would take up and burn any very badly infested trees.

A **Member**: Could the Scale be carried from California on fruit shipped to us.

Prof. **Webster**: Yes, it is carried all over the East; but how great the danger may be I do not know. The greater part of the fruit is consumed in towns and cities, and unless the infested fruit is thrown down so close to the trees that the young insects can make their way from the waste peeling to the tree, then there is no danger. I do not look upon this as a serious feature of the case, although it would be well to watch it.

LEPIDOPTEROUS PESTS OF THE MEADOW AND THE LAWN.

By the Rev. Thomas W. Fyles, F.L.S,, South Quebec.

I very much doubt whether I shall ever see again what was no uncommon sight on the older farms in the "flats" and "intervales" of Brome, Shefford and Missisquoi counties thirty years ago, viz. :—a field of Herd's grass *Phleum pratense*, L.), clean and tall, unspecked with Ox-eye (*Leucanthemum vulgare*, Lam), Cone-flower (*Rudbeckia hirta*, L.), and Charlock (*Sinapis arvensis*, L.).

I perfectly remember the first appearance of the Ox-eye daisy in Brome. A hot, dry season or two had made a scarcity of fodder, and men had gone down to the "French country" around St. Cesaire, St. Pie and St. Marie to buy hay. In the spring, a year or two years afterwards, an old-country farmer, Mr. Terence Courtney, of Iron Hill, pointed out to me, here and there by the wayside, along the line of travel, tufts of "the daisy" which had no doubt grown from seeds shaken from the loads brought in from the low country. He cut up those on his own farm, but his neighbors were not so careful, and now, in hay time, all the meadows round are white with the troublesome weed.

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* Note.—It has since been discovered that this treatment is not effective against the San José Scale unless applied for a longer time than can safely be done without injuring the trees treated. Dr. Howard, in a recent publication, "Some Scale Insects of the Orchard," says: "With the San José Scale the most satisfactory work can be done only with a winter wash." . . . "Up to the present writing, but one absolutely satisfactory winter wash against this insect in this locality has been found. This is whale-oil soap, a pound and a half or two pounds to the gallon of water."—J. Fletcher.

In those days there was much clearing of land on the hillsides and burning of brush heaps and log-piles, and the frequent fires and eddying smoke kept down the numbers of the insect pests of the meadow and the lawn.

The arable land, on which hardwood timber had formerly grown and which was free from stumps, was, in many districts, comparatively of small extent and was well worked. On the newly burnt land Indian corn, turnips and potatoes were grown for a season or two, and then Herd's grass seed was freely scattered to convert it into pasture.

In the neighborhood of South Quebec we have at the present day much slovenly farming. Last June I noticed a meadow in which the grass stood tall and rank and uniform, but it was a meadow of Couch (*Triticum repens*, L.). A meadow golden with that very handsome but most objectionable plant, the Hawkweed (*Hieracium Canadense*, Michx.), or blue with the Succory (*Cichorium intybus*, L) is often seen. A really good meadow of Herd's grass or clover is not common, and what an Englishman would call a fine lawn is hardly to be found in the province. The moist, salt air of the old country seems to be necessary to bring a lawn into perfect condition. It is not my present purpose to to tell of the agricultural remedies for this state of things. I have alluded to it because I wish to say that good tillage has a decided tendency to keep down the numbers of pernicious insects, and that in a well-considered and worked out succession of crops the meadow is likely to thrive. Fall plowing will expose many grubs and pupæ to the attacks of birds and the action of the frost; and cross-ploughing in the spring will give the birds further opportunities that they will be sure to profit by. The occasional removal of rail fences and the rooting out of the growth that springs up about them, will destroy the harbourage of numerous foes; and frequent mowing and the free use of the roller will not only beautify the lawn but crush out of existence many of its insect spoilers.

Of the Lepidoptera certain groups are especially *graminivorous*. They belong to t *Satyrinæ* and the *Hesperidæ* in the *Rhopalocera*; the *Ctenuchidæ*, the *Arctiidæ*, and the *Noctuidæ* in the *Heterocera*; and the *Crambidæ* in the *Pyralidina*.

SATYRINÆ

The Quebec Satyrinæ are:—*Debis Portlandia*, Fabr., *Neonympha Canthus*, Bd.-Lec., *Neonympha Eurytris*, Fabr., *Satyrus Nephele*, Kirby, *Chionobas Jutta*, Hübner.

The most common of them is *Satyrus Nephele*, Kirby, "The dull-eyed Grayling." It appears in July, and frequents the open fields and the borders of woods and copses. Around Montreal it is abundant, in its season, on thistle heads, in neglected spots.

It is brown, with a broad paler brown band near the outer edge of the fore-wings. In this band are two conspicuous eye-like spots. These consist of a bluish white central spot, surrounded by a black circle and a very pale outer circle. The under side of the wings has numerous dark brown cross markings. It lays its eggs in August, and the young larvæ hibernate in the first stage.

In colour the full grown larva is yellowish green, with a dark green dorsal line and a yellow stigmatic line. It has a reddish fork at the extremity of the body.

Neonympha Canthus (Fig. 85) is smaller than *Nephele*, and is of a light sandy brown. Its spots are more numerous, and each spot on the under side of the hind wings has *two* pale rings around the black one. NOTE.—*At the anal angle there are twin spots close together and thus encircled.* Canthus frequents upland meadows, and appears in July. The female lays her eggs in the end of that month.

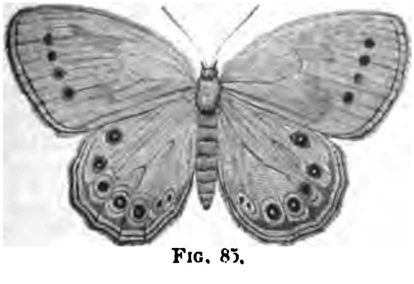


FIG. 85.

The larva is green, with darker green and yellow longitudinal lines, and it has cephalic and terminal horns. It hibernates in the last stage of its growth.

But a more hurtful, because more numerous, group of grass feeders are to be found among the

HESPERIDÆ.

They belong to the genus Pamphila in the Hesperidæ, and are commonly called "Skippers (Fig. 86). The most common of the Quebec species are :—*Pamphila Hobomok*, Harris; *P. Manitoba*, Scudder; *P. Peckius*, Kirby; *P. Mystic*, Scudder, and *P. Cernes*, Edwards. The three last may be seen in June and July scudding about the meadows in droves.

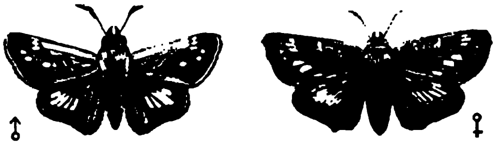


FIG. 86.

Mr. W. Saunders, of London, Ontario, succeeded in raising *P. Mystic* from the egg to the pupa, and has described the changes of the larva in the *Canadian Entomologist*, Vol. I., p. 65. The larva was full-grown in August. It was an inch long, onisciform, downy, with a dull reddish-brown head and a dull brownish-green body. It had many dots of a darker hue and a dark dorsal line. The second segment was whitish with a dark line across the upper surface.

Mr. Fletcher, of Ottawa, raised *P. Cernes* from the egg to the pupa. The eggs were laid on grass on the 10th of July, and hatched on the 23rd of that month. The larva was full grown in September. It was an inch long, of a purplish-brown color, mottled with grey and dark purplish-brown, and it was covered with fine, short, black hairs. It had a black head and a thoracic shield on a white collar. The spiracles were black.

Both *Mystic* and *Cernes* hibernate in the chrysalis.

P Metacomet, Harris, hibernates as a larva (Fletcher, *25th Rep. Ent. Soc. Ont.*, p. 4).

P. Manitoba, Scudder, spends eight months, or two-thirds of its existence, in the egg. The young larvæ appear in April and are full grown in July. The butterflies come forth in August, and lay their eggs in the same month. For the life history of the species see *Canadian Entomologist*, Vol. XXVII., p. 346.

CTENUCHIDÆ.

Of this family two species are common at Quebec, *Scepsis fulvicollis*, Hubner, and *Ctenucha virginica*.

The imago of *S. fulvicollis* appears in the beginning of June. Its expanse of wings is about an inch and two-tenths. Its head and body are of a deep velvety purple. The antennæ are pectinated in the male, and dentated in the female. The striking feature in the insect is the broad yellow collar from which it derives its specific name. The forewings are of a somewhat bronzy black with the costa obscurely yellow. The secondaries are semi-transparent with black veins, and with the inner and hind margins clouded with purplish black.

The full-grown larva of this species is one inch long. Its head is glossy yellow, and its body is slate colored, striped with green, pink and pale yellow, and it has a number of small warts set with white hairs. At the end of July or the beginning of August it spins its cocoon.

Ctenucha virginica, in general appearance, resembles *Fulvicollis*, but it is a larger insect; its expanse of wings is an inch and a half. The secondaries are of a deep blue-black, with whitish edges.

The larva of this species, when full-grown, forms a cocoon of the spinulated hairs from its body; it plucks them out and arranges them, and they adhere firmly in the required shape. (*Packard's Guide*, p. 239.)

ARCTIIDÆ.

The Arctian larvæ that have been found injurious to the meadows are chiefly those of *Pyrrharctia Isabella*, Smith and Abbott, and *Leucarctia acræa*, Drury ; both are well known. The former is that brush-like caterpillar, Fig. 87 *a*, black at the ends and chestnut red in the middle, that so often is found under boards and in out-buildings late in the fall and in the early spring. When disturbed, it rolls itself up hedge-hog fashion. It forms its cocoon, Fig. 87 *b*, in May, and the perfect insect, Fig. 87 *c*, appears in June. This last is two inches and a quarter in expanse of wings. Its colour is yellow, with indistinct wavy lines on the primaries and with dark brown spots on all the wings, and also on the abdomen. The secondaries are sometimes tinged with red.

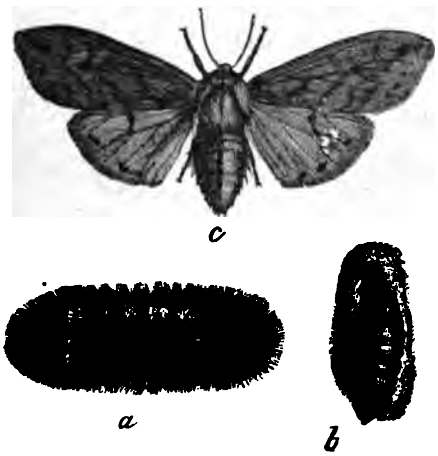


Fig. 87.

The larva of *L. acræa* is the "salt-marsh caterpillar," the ravages of which have been so well described by Harris in his *Insects Injurious to Vegetation*, pp. 351-355. It is about an inch and three-quarters in length and is clothed with long hairs, which are dark brown on the back and lighter brown on the sides Its spiracles are white. This caterpillar appears in June and attains its growth in the end of August, when it spins its cocoon. Of late years the numbers of the "Woolly Bears," as they are commonly called, have been greatly reduced by a fungus which spreads among them and destroys their vitality.

NOCTUIDÆ.

The Noctuids are the night-flying or owlet moths. Their name is derived from the Latin *Noctua*, an owl. These moths, on warm, moist evenings, often beat at the windows of our country houses, attracted by the light. In dress they are a sober "people"—browns and drabs prevail amongst them. But innocent as they are in appearance, they, through their larvæ, work incalculable harm. Amongst these larvæ are the various species commonly classed as "cut-worms." Amongst them, too, is the dreaded "army worm."

Of the cut-worms, one that has been particularly marked as injurious to the hay crop is *Peridroma saucia*, Hübner. Of this there are two broods in the year (*Lintner's 5th Report*, p. 64). The eggs of the first hatch in the beginning of May, and the larvæ attain their grown in the beginning of June. The full grown caterpillar is about an inch and a half long. It is of a dirty greyish brown, with spots and markings of yellow and dark brown. The moth leaves the chrysalis in about twenty days, *i e.*, in the end of June. It is an insect of considerable size, the wings expanding about an inch and three-quarters. Its colour is brownish or ochreous grey, clouded and spotted with brown and with stigmata outlined with brown. The second brood appears in the fall.

Nothing in the vegetable line seems to come amiss to the caterpillars of this species. In the meadows they strip the clover and cut off the heads of the timothy ; and even the roots of the grasses are devoured by them.

The larva of *Noctua fennica*, Tausch, is another of the grass eating cut-worms. When full-grown it is about an inch and a quarter long In colour it is velvety black, with two irregular and broken yellowish stripes on each side. Its head is brown, with a black stripe down the front, and it has a black, horny shield on the second segment. In May, 1884, Mr. Fletcher found it exceedingly destructive in meadows around Ottawa; and in the same year it abounded in the meadows of Michigan to such an extent that, to use the words of Professor Cook, of the Agricultural College of that State : "There were meadows through which one could not walk without crushing from a dozen to a hundred at each step."

The moth is not quite as large as *P. saucia.* Its head and thorax are dark brown; the fore-wings are dark brownish grey, with a purple blush; the stigmata are clay-yellow. The renal stigma often takes the form of the letter R; near the hind margin are two small, angulated, black marks.

Another very mischievous insect of the kind we are considering is the "glassy cut-worm," *Hadena devastatrix*, Brace. It bites away the roots in the sod till the grass comes off in patches. I have seen considerable spots in the pastures and meadows of Brome laid bare by this pest.

The eggs of the species hatch early in May; and the larvæ attain their growth in about four weeks. They are glossy green in colour, with the head red, and the thoracic shield dark brown.

The moth has dark ash-grey fore-wings, with several white lines across them and some angulated black spots near the hind margin. The stigmata are black, outlined with white.

These cut-worms have been very destructive to meadows in the past, and may be again; and it is possible that other species may become so.

Another group of the noctuidæ injurious to meadows belongs to the genus *Leucania.* A very common species in the group is *Leucania pallens*, Linn., the "Wainscot moth." It may be known by its sandy fore-wings finely lined with a little darker colour, and by the three tiny black dots arranged in a triangle beyond the middle of the wing. It has white satiny hind-wings with a few brown streaks.

Leucania Henrici, Grote has dull white fore-wings with pale brown streaks. It has no black dots, and the hind-wings are clear satiny white.

Leucania commoides, Gn. is a much darker species, and may be known by the white line in the middle of the fore-wing thrown out by dark brown on either side, and branching into white lines with dark brown streaks between them. The hind-wings are dark with dark brown veins.

Leucania albilinea, Hubner is the smallest of the Canadian species known to me. It is not so dark as *commoides*, and the white central streak is branchless. This streak is thrown out by a brown one on the inner side, and, on the outer, by another which widens as it approaches the hind margin where it spreads on both sides. There is also a paler brown stripe along the costa. The secondaries are clouded towards the hind margins and have brown veins. Fig. 89 represents the eggs much magnified, and the caterpillars on an ear of wheat.

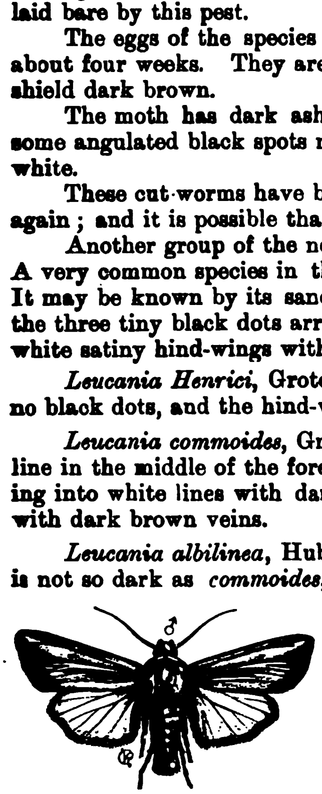


Fig. 88.

The two largest of our Quebec Leucanians are *L. unipuncta* Harv. (the Army-worm moth), and *L. pseudargyria* Guen. They somewhat resemble each other, but *Unipuncta* is of a pale reddish brown, or russet hue. *Pseudargyria* is of the tint known in the old country as "whity-brown." Moreover *Unipuncta* has a small but conspicuous milk-white dot in the middle of the fore-wing—hence its name. In place of it Pseudargyria has a pale circle, sometimes imperfect, enclosing a black dot.

When I went to live in Montreal in 1861, ("the Army-worm year"), I noticed, on the Cote-des-Neiges' road, on the wall enclosing the "Priests' Farm," a broad black line, about two feet from the ground, extending the whole length of the wall. I found it was of tar; and, on enquiring as to its purpose, I was told that it was intended to stop the Army-worm in its march from the mountain.

L unipuncta the One-spotted Leucanian lays its small,

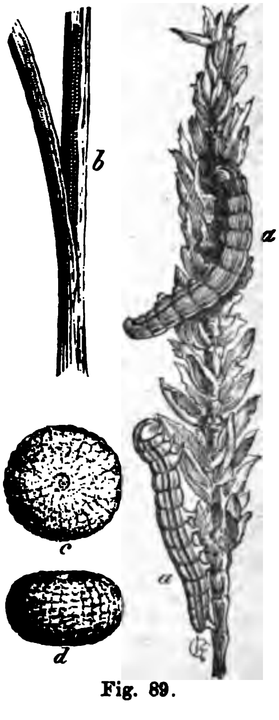


Fig. 89.

round, white eggs at the base of the stems and within the folds of the blades of grass. They hatch in eight or ten days, making their appearance in May. In a month the larva is full grown. It is dull black lined with with white, yellow, and pink. It buries itself, forms a cist, and then turns to a mahogany brown chrysalis. The moth appears in about a fortnight.

The Army-worm in its strength is indeed a formidable foe—"The land is as the garden of Eden before it, but behind it a desolate wilderness." A correspondent of the *American Entomologist* told of the creatures coming down upon his lands in a phalanx half-a-mile wide.

Happily for the farmer there are two powerful natural checks to the increase of these troublesome pests; and often when he is at his wit's end *they* are most effective in his service. One is a fungus which spreads from larva to larva and speedily paralyzes and consumes them: the other is the Red-tailed Tachina fly, *Nemoræa leucaniæ*, Kirkpatrick, which lays its eggs upon the living larva in parts where it cannot dislodge them. The maggots that burst from the eggs destroy their victims by thousands.

CRAMBIDÆ.

A very elegant, but very mischievous group of moths are the Crambidæ or "Grass moths," of which we have many species. Their larvæ form silken tunnels at the roots of grasses and work unseen. Their retiring habits make it difficult to follow them in their career; and but little is known of the life histories of most of the species. Dr. Lintner has given us a good account of *C. vulgivagellus*; and other writers have afforded us glimpses of a few of the rest. In the dearth of information the following particulars concerning *C. Girardellus* may be of interest.

NOTES ON CRAMBUS GIRARDELLUS.

Eggs.—Laid dispersedly, pale yellow, melon-shaped, ribbed and cross-lined; hatched the first week in August.

Young larva.—One-twentieth of an inch long; head and second segment dark brown, rest of body amber coloured; formed dirty silken tunnels at the roots of the grass; moulted August 20th.

Larva after first moult.—Length, one sixth of an inch; head and horny plate on second segment dark brown, polished; body pale amber beautifully spotted with sienna-coloured warts, and sparingly set with bristles; moulted September 1st.

Larva after second moult.—Head of a dirty amber colour, marked with brown patches; body amber-coloured, dotted with large brown tubercles.

At this stage I lost my specimens—the frequent disturbances necessary to the observation of their habits proving destructive to them.

The following is a table of the Quebec specimens of this interesting group:

CHARACTERISTICS OF THE GROUP.

Antennæ filiform; labial palpi long and beak-like, porrected; wings in repose folded round the body; fore-wing usually oblong and, in most instances, bluntly terminated, but sometimes, as in *C. minimellus*, with a produced tip. Hind-wings ample.

Larva with sixteen legs; head and thoracic shield usually black or brown; body whitish or straw-coloured, somewhat hairy, and sometimes having glassy tubercles. It forms silken galleries at the roots of grasses.

TABLE OF SPECIES.

A.—*Fore-wings white.*

a. Pure silvery white.
C. perlellus, Scop.

b. Satiny white with several dark brown dots.
C. turbatellus, Walker.

c. Satiny white with a reddish brown dot in the middle of the inner margin, and a reddish brown terminal line.
Argyria nivalis, Drury.

d. Satiny white with an orange band across the wing.
A. auratella, Clemens.

e. Satiny white, with a longitudinal orange stripe bordered with brown and widened into a foot near the hind margin.
C. Girardellus, Clem.

f. White with brown patches and cross-lines.
C. elegans, Clem.

B.—*Fore-wings golden.*

g. Golden with a silvery stripe running throughout and widened at the hind margin.
C. unistriatellus, Packard.

h. Golden with a silvery stripe ending in a point near the sub-terminal line.
C. Leachellus, Zincken.

i. Golden with a very broad silvery stripe ending in a point and having a conspicuous tooth on the inner side.
C. bidens, Zeller.

C.—*Fore-wings ochreous.*

j. Brownish ochreous, with a short, broad and pointed, silvery dash followed by a silvery stroke.
C. alboclavellus, Zeller.

k. Pale ochreous, with a silvery dash divided by a yellow streak.
C. agitatellus, Clemens.

l. Ochreous, with two silvery parallel streaks, the second longer than the first.
C. laqueatellus, Clemens.

m. Pale ochreous, with brown lines and an angulated silvery line bordered with brown near the hind margin.
C. hortuellus, Hübner.

n. Pale ochreous, with fuscous longitudinal lines, and two fuscous transverse curved lines.
C. ruricolellus, Zeller.

o. Pale brownish ochreous with brown lines and two darker brown transverse curved lines.
C. trisectus, Walker.

p. Reddish ochreous with two wavy, somewhat indistinct cross-lines.
C. luteolellus, Clemens.

q. Brownish ochreous with numerous brown streaks.
C. vulgivagellus, Clemens.

D.—*Fore-wings brown.*

r. Glossy reddish brown, with a broad silvery stripe divided into three parts of diminishing length.
C, myellus, Hübner.

s. Dark brown with white markings and black spots.
C. Labradoriensis, Christoph.

E.—*Fore-wings brownish lilac.*

t. Brownish lilac (fugacious) with stripe and other markings white.
C. minimellus, Robs.

Note.—*A. nivalis* is taken at Sherbrooke ; *A. auratella* and *C. laqueatellus*, in the Island of Montreal ; *C. Labradoriensis* and *C. minimellus* at Bergerville, *C. myellus* at Levis.

The foregoing information as to the times of appearance, habits, etc., of the different species of the grass eating larvæ will have prepared the way for this declaration :

THE VERY BEST PREVENTIVE TO INJURY FROM THE LEPIDOPTEROUS PESTS OF THE MEADOW AND THE LAWN IS THE USE OF THE IRON ROLLER

The best form of roller for field use is the toothed roller formed in sections. This should be passed over the meadows in spring when the grass begins to shoot, and, if possible, at night, for then both the hibernated and the newly-hatched larvæ will have left their retreats and be at work.

Again the roller should be used after the hay-crop has been taken from the fields, for it will then kill such larvæ and pupæ as have been shaken into the under-growth.

Of course in the use of the roller as in other things, judgment needs to be exercised. *It would not do to pass it over heavy clay-lands in wet weather.*

When an assault of the Army-worm upon standing crops is anticipated, a deep furrow should be run around the meadow. This would disconcert and entrap the foe ; and a suitable log attached by a chain to a whiffle-tree should be in readiness, to draw along the trench, as often as may be necessary, for the purpose of crushing the assailants.

The use of Paris green about the meadows and pasture lands cannot—under ordinary circumstances—be recommended. It is far too dangerous.

RARE CAPTURES DURING THE SEASON OF 1896.

BY ARTHUR GIBSON, TORONTO.

It is my intention here to give the benefit, if any, of a few notes I made, and to briefly describe some of the rarer captures and observations in Lepidoptera, which have personally come under my notice during the collecting season just closed.

The present year has been a most remarkable one for the appearance and capture of interesting and rare specimens of Lepidoptera, in and about the neighborhood of Toronto. Butterflies which have never been recorded as having been taken in this part of Ontario, previous to this year, have been collected in considerable numbers during the past summer, while others which were seldom seen on the wing here have been observed and taken again and again. It is something very unusual for this locality to see so many strangers in the butterfly line, as have paid a visit to Toronto throughout last summer. Whether we shall see the same insects here again next year remains to be seen.

The very first specimen which I met with this last season proved to be a good one, and one which I was exceedingly pleased to get. While out on Saturday afternoon, the 11th April, getting some larvæ of *Arzama obliquata*, I took my first specimen of *Brephos infans*. This beautiful moth I found lying in a small pool of water, where the ice had melted, close to the bank leading down to the marsh. It was a perfect specimen and I presume had probably just emerged from the pupa, and fallen into the water, where it had ended its short existence.

Argynnis Atlantis,—This butterfly was very common at the Forks of the Credit, on the 1st July, especially on the milk weed, where it could have been taken in any numbers.

Argynnis Bellona.—Appeared to be fairly common at Lorne Park. Took two specimens on the 11th July. Saw several more.

Argynnis Myrina.—To me this insect was very rare this last summer. Only saw one specimen during the whole season, and that I took in the early part of the summer.

Libythea Bachmani.—This very pretty butterfly, Fig. 90, so easily recognized by its long palpi and angled forewings is seldom met with in Canada. I had the pleasure of taking a perfect specimen at Caesarea, Lake Scugog, on the 12th August last. The only previous Canadian captures of this insect, which have been recorded up to August, of this year, have been made at Toronto, Port Stanley, London and Hamilton.

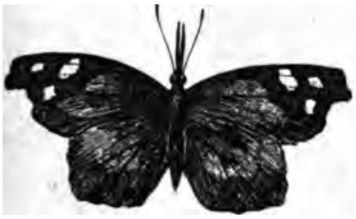


FIG. 90.

Chrysophanus Thoe.—(Fig. 91 the male; Fig. 92 the female.) Although this insect has often been met with in Toronto, I have never taken it here. While away on my holidays, I took my first specimen at Caesarea, on the 12th August. Only saw the one specimen.

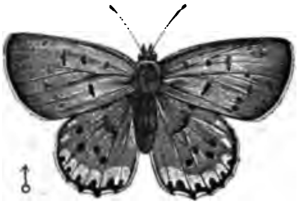


FIG. 91.

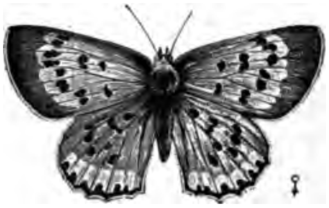


FIG. 92.

Pieris Napi—Summer form *Oleracea-æstiva.*—This butterfly was very common at the Forks of the Credit, on the 1st July. I could have taken any number of specimens but confined myself to about 30. I also took this insect at Caesarea, Ont., on the 12th August, where it also appeared to be fairly common. I might add that I took one specimen at Lorne Park, on the 11th July.

Meganostoma Caesonia.—(Fig 93) As has been previously mentioned this insect made its first appearance in this neighborhood during the past season, and was fairly common. The first time I noticed it was on the 13th June, when I took three specimens, and also observed it several times later in the same month, and on the first of July at the Forks of the Credit.

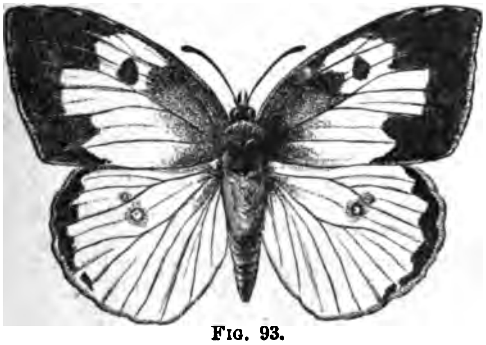


FIG. 93.

Papilio Ajax.-While strolling through High Park, on the afternoon of the 14th June, I observed, to me, the first living representative of this Papilio flying very slowly over some small bushes. On June 20th I succeeded in taking a worn specimen and on the 23rd of the same month saw another specimen which looked to be perfect, but as I did not have any appliances handy, did not take it. I also observed this butterfly on the 1st and 11th July.

Papilio Philenor.—(Fig. 94.) I should not like to say for sure, but I am pretty well satisfied that I saw a specimen of this butterfly in High Park, on the 20th June. Gave chase to it but to no effect. I do not know whether this Papilio has ever been taken in Toronto or not.

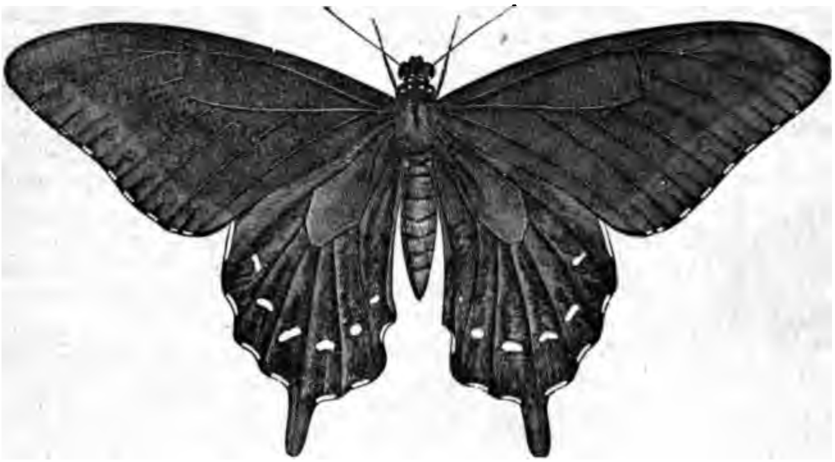


FIG. 94.

Catocala cerogama.—This was one of our commonest Catocalas here this year. One night alone over twenty specimens were taken. It is usually a rather uncommon moth, and of late years has not been met with very often.

Catocala ilia—This beautiful moth was quite plentiful at "sugar" during the past season. I took my first specimen on the 20th July and also secured it several times later.

Catocala neogama.—I took one specimen of this insect on the 3rd August. This is considered to be a rather rare Catocala in this locality.

Catocala retecta.—The black underwings are always eagerly sought after. Several *retectas* were taken here this year. I took my first one on the 24th August.

Catocalas were unusually early this year, most of them being taken in July and August, while in other years I have always taken them towards the end of August and beginning of September.

THE BUTTERFLIES OF THE EASTERN PROVINCES OF CANADA.

BY REV. C. J. S. BETHUNE, PORT HOPE, ONT.

In our 25th Annual Report for 1894, pages 29-44, I gave a list of the Butterflies of the Eastern Provinces of Canada, so far as known to me, with localities and other observations. So many interesting records and rare captures have been made since its publication, in addition to those given in the preceding paper by Mr. Arthur Gibson, that it seems desirable to publish them here. For convenience of reference, I prefix to the name of the species the number given in the 1894 list.

1. DANAIS ARCHIPPUS, *Fabr.*—Halifax, N. S., rare: Mr. Harry Piers (Proc. Nova Scotia Institute of Natural Science, vol. ix., part I., page xix.)

2. Euptoieta Claudia, *Cram.*—This rare butterfly (Fig. 95) was taken in High ırk, Toronto, by Mr. Arthur Gibson, in July, ›93.

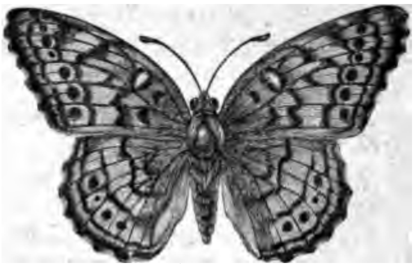


Fig. 95.

3. Argynnis Cybele, *Fabr.*—Taken at ıdbury (J. D. Evans); Orillia, common June to August 31 (C. E. Grant). Miss Eaton entions its capture at Truro, N. S., but Mr. ers considers that there is some doubt about identification. (Proc. N. S. Institute—*loc cit*).

4. Argynnis Aphrodite, *Fabr.*—Orillia, June to August (C. E. Grant); Halifax, N. S., undant (H. Piers).

5. Argynnis Atlantis, *Edw.*—This northern species has greatly extended its nge and is now recorded from Orillia, common June 4 to August (C. E. Grant); Toronto d Port Credit, June, July, and August, 1896 (C. T. Hills); London, Sarnia, and 'indsor, June and July, 1895 (J. A. Moffat); Truro, N. S., very common (Miss Eaton).

8. Argynnis Myrina, *Cram.*—Orillia, common, two broods, June and August, C. Grant); Truro, N. S., (Miss Eaton); Halifax (H. Piers).

9. Argynnis Chariclea, *Ochs.*—"Ranges from Labrador, Hudson Bay and Gulf St. Lawrence on the east to probably about lat. 51' 25° on the Pacific Coast, nowhere tending into the United States." (F. M. Webster, Can. Ent. xxvi. 119.)

10. Argynnis Freija, *Thunb.*—"Alaska to Labrador and westward to the Rocky ountains, which range it follows southward to Colorado, about lat. 39°." (F. N. 'ebster); Calgary (Wolley Dod).

118. Argynnis Idalia, *Drury.*—This lovely addition to the list of Canadian Butteres was taken at Windsor, Ontario, last year, by Mr. W. S. Cody, who kindly presented ıpecimen to the Society's cabinet. St. John, N. B. (H. E. Goold

13. Melitæa Phaeton *Drury*—Very rare at Truro, N. S. (Miss Eaton); alifax, (H. Piers).

15. Phyciodes Nycteis, *Doubl-Hew.*—Orillia, fairly common in June (C. E. rant); Port Hope, second week in June, 1896. Fig. 96.

17. Phyciodes Batesii, *Reak.*—Mr. C. E. Grant has taken one specimen of this rare ıtterfly in July, at Orillia, Ont.

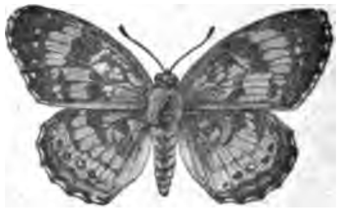


Fig. 96.

18. Phyciodes Tharos, *Drury*—Orillia, common ay 24th to July, (C. E. Grant); Truro, N. S. Miss Eat-); Halifax: "very common throughout the Eastern 'ovinces" (H. Piers).

19. Grapta Interrogationis, *Fabr.*—Has usually en considered a rare butterfly in the Province of Quebec, ıt this year it has been found in great abundance, the rvæ feeding on elm, in the neighbourhood of Montreal. ıe form *Umbrosa* was abundant at Port Hope in May d June, and *Fabricii* was taken July 29, and as late as November 16, 1896.

20. Grapta Comma, *Harr.*—Sudbury (J. D. Evans); both forms fairly common at 'illia, (C. E. Grant).

22. Grapta Faunus, *Edw.*—Sudbury (J. D. Evans); Orillia, rare (C. E. Grant); uro, N. S. (Miss Eaton).

23. Grapta Progne, *Cram.*—Orillia (C. E. Grant); Truro, N. S., not common (Miss ıton).

24. Grapta Gracilis, *Grote and Rob.*—Orillia, two specimens in July (C. E. Grant.

25. Grapta J. Album, *Boisd.-Lec.*—Sudbury (J. D. Evans); Orillia, common in September (C. E. Grant); Truro, N. S., very rare (Miss Eaton).

26. Vanessa Antiopa, *Linn.*—Truro, N. S. (Miss Eaton).

27. Vanessa Milberti, *Godt.*—Sudbury and Orillia, Ont.; Truro, N. S.

28. Pyrameis Atalanta, *Linn.*—Sudbury and Orillia, Ont.; Halifax, common (H. Piers).

30. Pyrameis Huntera, *Fabr.*—Orillia (C. E. Grant); Halifax, occasionally abundant (H. Piers).

31. Junonia Cænia, *Hubn*—Don River Valley Toronto, May 23, 1896 (C. T. Hills); two specimens at Toronto in 1895 (C. H. Tyris).

32. Limenitis Arthemis, *Drury.*—Sudbury and Orillia, Ont.; Truro, N. S.

34. Limenitis Ursula, *Fabr.*—Fig. 97.—Taken at Niagara Falls, Ont., June 25, 1895, and at Port Credit by Mr. C. T. Hills.

35. Limenitis Disippus, *Godt.*—Orillia, second brood in July and August in low lands (C. E. Grant); Truro N. S. (Miss Eaton).

36 Debis Portlandia, *Fabr.*—Sudbury (J. D. Evans); two specimens were taken at Matchedash Bay, near Coldwater, County of Simcoe, Ont., August, 1883 (C. E. Grant). Fig. 98.

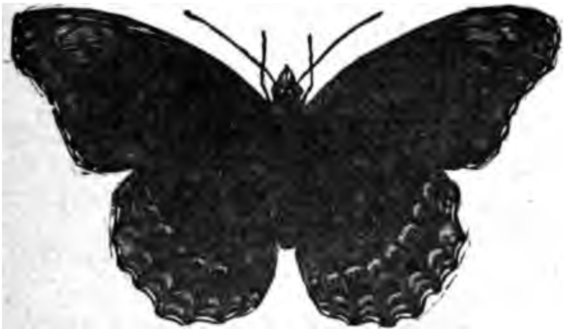


Fig. 97.

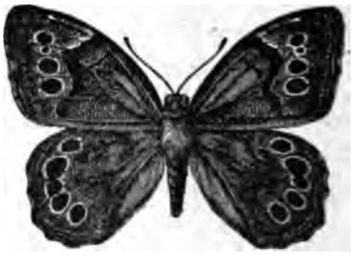


Fig. 98.

37. Neonympha Canthus, *Boisd.-Lec.*—Sudbury; Orillia, common in low meadows in July (C. E. Grant); Truro, N. S.; and Lower Stewiacke, N. S. (H. Piers).

38. Neonympha Eurytris, *Fabr.*—Orillia, common in open woods in June (C. E. Grant).

42. Satyrus Alope, *Fabr.*—Niagara Falls, Ont., July 14, 1896 (A. Gibson); Truro, N. S., rare (Miss Eaton).

45. Libythea Bachmani, *Kirtl.*—Taken in Toronto in 1895, and June 7, 1896, by Mr. McDonagh. Fig. 90.

46 Thecla Acadica, *Edw.*—Orillia, usually rare, but very abundant in July, 1896, when forty specimens were taken by Mr. Grant; Toronto, June and July (C. T. Hills).

48. Thecla Edwardsii, *Saund.*—Toronto, June and July (C. T. Hills).

49. Thecla Calanus, *Hubn.*—Sudbury (J. D. Evans); Orillia, rare, taken in July (C. E. Grant).

50 Thecla Ontario, *Edw*—A specimen of this extremely rare butterfly was taken near Grimbsy on the 24th of June, 1894, by Mr. Wm. Metcalfe of Port Hope. The only specimen previously known was taken twenty-six years before at Port Stanley by Mr. E. Baynes Reed.

51. THECLA STRIGOSA, *Harr.*—This rare butterfly, Fig. 99, was taken at Orillia in July by Mr. Grant, and at Toronto in June and July by Mr. C. T. Hills.

119. THECLA HUMULI, *Harr.*—This is another addition to the list of Canadian butterflies; it was taken at Sudbury by Mr. Evans.

58. FENISECA TARQUINIUS, *Fabr.*—Orillia, moderately common in one locality C. E. Grant).

63. CHRYSOPHANUS HYPOPHLÆAS, *Boisd.*—Orillia (Grant); Truro, N. S., very common (Miss Eaton).

67. LYCÆNA PSEUDARGIOLUS, *Boisd.-Lec.*—Orillia; the form *Lucia* is very common in April and May; *Neglecta* is not so abundant in July and August C. E. Grant); Truro, N. S., rare (Miss Eaton); Halifax, "abundant in the spring and familiar to trout fishermen under the common name of 'Jenny Lind'" (H. Piers).

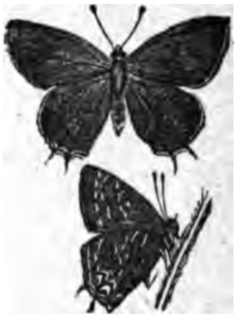


FIG. 99.

68. LYCÆNA COMYNTAS, *Godt.*—Toronto in June (C. T. Hills).

69. PIERIS PROTODICE, *Boisd.-Lec.*—Orillia, formerly common; one male was taken in August, 1895 (C. E. Grant

70. PIERIS NAPI, *Esper.*—Orillia, the spring and summer forms are common; *Virginiensis* has also been taken (C. E. Grant); Truro. N. S., not very common (Miss Eaton).

71. COLIAS CAESONIA, *Stoll.*—Fig. 93.—The sudden appearance of this butterfly in considerable numbers in several localities in Ontario during the summer of 1896, is very remarkable. It was taken at Orillia by Mr. James Walker on July 13, and by Mr. Grant from June 6 to July 13; at Toronto by Messrs. C. T. Hills, C. H. Tyris and A. Gibson from June 11 to the end of the month; Little York, near Toronto, June 14. It was also taken at Cartwright, Manitoba. on June 19 by Mr. E. Firmstone Heath.

72. COLIAS EURYTHEME, *Boisd.*—Sudbury (J. D. Evans); Orillia, common in 1872, not seen since (C. E. Grant).

78. TERIAS MEXICANA, *Boisd.*—No further record, but a cut is given, Fig. 100, to aid in its identification should it again make its appearance in south-western Ontario.

79. PAPILIO AJAX, *Linn.*—Port Hope at the end of May and on June 18, 1896; Toronto, four specimens during June C. T. Hills), in addition to those observed by Mr. Gibson.

81. PAPILIO CRESPHONTES, *Cram.*—Taken at Orillia by Mr. Grant. In 1894 we gave a figure of this splendid butterfly and are now able to present pictures of the caterpillar, Fig. 101, and the chrysalis, Fig. 102.

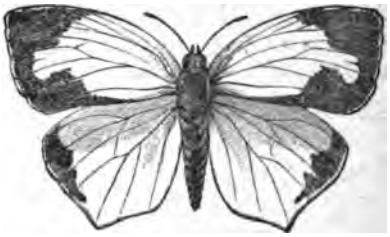


FIG. 100.

85. PAPILIO PHILENOR, *Linn.*—A specimen was taken at Port Hope, on the 5th of August, 1896; this is the first time it has been observed east of Toronto in this Province. Fig. 94.

87. ANCYLOXYPHA NUMITOR, *Fabr.*—Humber River, near Toronto, and at Port Credit, in June, July and August (C. T. Hills).

89. PAMPHILA ZABULON, *Boisd.-Lec.*—The form *Hobomok* was abundant in sunny places in the woods near Port Hope during the first and second weeks in June, 1896; both forms common at Orillia in May and June (C. E. Grant).

94. PAMPHILA MYSTIC, *Scud.*—Orillia, common in June and August, two broods (C. E Grant); Truro, N. S. (Miss Eaton).

95. Pamphila Oernes, *Boisd.-Lec.*—Sudbury (Evans); Orillia (Grant); Truro, N. S. (Miss Eaton).

97. Pamphila Metacomet, *Harris.*—Toronto in July (C. T. Hills); Orillia, scarce, in July (C. E. Grant).

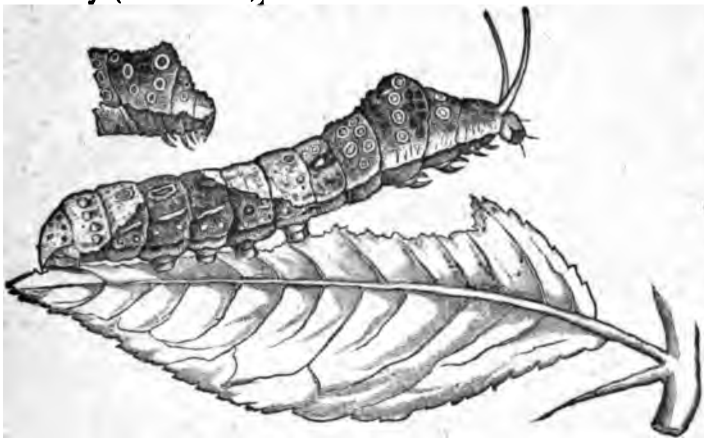


Fig. 101.

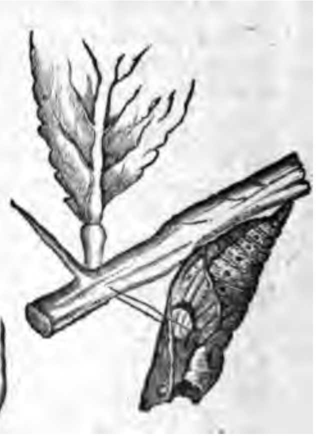
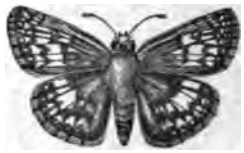


Fig. 102.

104. Pyrgus Tessellata, *Scud.*—This rare butterfly, Fig. 103, which has only been recorded in Canada as having been taken in Essex County, Ontario, many years ago, was taken in the early part of October, 1895, by Mr. Anderson, at London, Ont.



Fi 103

106.—Nisoniades Brizo, *Boisd.-Lec.*—Orillia, scarce (C. E. Grant).

107. Nisoniades Icelus, *Lint.*—Orillia, not uncommon in May, June and July (C. E. Grant .

108. Nisoniades Lucilius, *Lint.*—Orillia, scarce C. E. Grant).

109. Nisoniades Juvenalis, *Fabr.*—Sudbury (J. D. Evans); Orillia, not uncommon in May and June (C. E. Grant).

112. Pholisora Catullus, *Fabr.*—Orillia, rare, June (C. E. Grant).

114. Eudamus Pylades, *Scud.*—Port Hope, abundant in sunny places in the woods during the first two weeks of June, 1896; Orillia, abundant at the end of May and in June (C. E. Grant).

OBITUARY.

John M. Denton.

It is with profound regret that we record the death of our old friend and highly esteemed colleague Mr. John M. Denton, of London, Ontario, who was one of the early members of the Entomological Society and always took a very lively interest in its welfare. For some months he had been in poor health owing to an affection of the liver, but was able to attend his place of business from time to time and to take part in the proceedings of our annual meeting in November 1895, when many of us saw him for the last time. In January, his illness assumed a more acute form and confined him to the house. On Tuesday, March 24th, he was seized with paralysis and before midnight passed peacefully away.

Mr. Denton was born in Northampton, England, on the 19th of September, 1829. His father was a farmer by occupation, and he was consequently brought up in the country amidst rural scenes and learnt there to love and observe the beauties of nature. At the age of fourteen he was apprenticed to a woollen draper and tailor, and spent seven years in thoroughly learning the trade and becoming proficient in all its details. For a few years he was engaged in business on his own account, and in 1855 married Miss Ann Walker, of Somersetshire, England, who survives him. He then emigrated to Canada and settled in London and at once resumed his occupation as a tailor, having but little to begin upon, except a hopeful heart and a thoroughly practical English training. By patient industry, unfailing courtesy and unswerving integrity, he built up by degrees a most successful business as a merchant tailor, and won the respect and esteem of the whole community.

Living on a farm in his boyhood and apprenticed at so early an age, he had but little opportunity of acquiring a literary education, but by constant application and careful reading he overcame these disadvantages, and attained a more than ordinary knowledge of the subjects that interested him. Foremost among these was Entomology, which he studied especially in its economic aspects as affecting live stock, fruit trees, garden and field crops. He became an authority on these topics and was frequently called upon to address meetings of farmers and fruit growers and give them the benefit of his knowledge and experience. His love of the farm continued throughout his life and he devoted much of the time that he could spare from business to the cultivation of a fruit farm a few miles from London. He was no mean authority upon horses and cattle and had a considerable knowledge of their diseases and most satisfactory treatment. He was also an adept with the microscope and took great delight in searching into the hidden beauties of nature.

When the London branch of the Entomological Society was formed in July, 1864, he was one of the original members, and took a most active interest in it and the parent Society to the close of his life. He was elected Vice-President of the London branch in 1872, and President in 1878 and several years following. In 1871, he became a member of the Council of the parent Society and continued to hold office for five and twenty years; in 1892 he was elected Vice-President, but he would never allow himself to be nominated for the Presidency, though urged to do so more than once. He was also an active member of the Ontario Fruit Growers' Association and gave much assistance to its work.

He was a man of deep religious feelings and of earnest but unobtrusive piety. Though a leader of the Plymouth Brethren, he never obtruded his views upon those who differed from him. The writer knew him well for a great number of years, and during his visits to London often enjoyed his hospitality, but never did he hear a word fall from his lips that could wound in the slightest degree the susceptibilities of those who did not accept the theological opinions that were so dear to him. He was a good, honest, sterling man, whom all respected and whom his friends loved; kind, charitable and generous; courteous in manner, most hospitable in his home, above reproach in business; a man who is a distinct loss to the city in which he lived, and whose death creates a blank in the hearts of his friends which can never in this life be filled. To his childless, sorrowing widow we tender our deepest, sincerest sympathy.

C. J. S. B.

CAPTAIN J. GAMBLE GEDDES.

It is our painful duty to record the loss of another active member of the Entomological Society of Ontario. A 2 o'clock on Good Friday morning, April the 3rd, Captain J. Gamble Geddes died after a few days' illness brought on by a severe cold. He was born in Montreal in 1850 and educated there. When a young man he entered the service of the Molsons Bank and was for some time attached to the office in London. He at once joined the Society and became an enthusiastic member. In 1874 he was elected Secretary-Treasurer of the London Branch; in 1875 Vice-President; and in 1876 President. He left London on his appointment as Manager of the agency of Molsons Bank at Millbrook. Here living in the country he devoted most of his leisure time to the collection and study of insects, applying himself especially to the Lepidoptera. In 1880 he left the bank and was appointed aide-de camp and private secretary to the Hon. John Beverley Robinson during his term of office as Lieutenant-Governor of Ontario. Being fond of society, of handsome presence and devoted to music, he became a great favourite among the social circles of Toronto, among whom much of his time was accordingly spent. He did not, however, abandon the pursuit of Entomology, but succeeded by correspondence and exchange, in addition to the captures of his own net, in forming a large and valuable collection of butterflies from all parts of the world. This he subsequently sold to the Dominion Government and it now forms the nucleus of the collection in the Geological Museum at Ottawa. He made expeditions in 1883 and 1884 to Manitoba and the Northwest Territories as far as the Rocky Mountains in quest of butterflies and added much to the knowledge of their geographical distribution and habits. On several occasions he visited England, and spent some time in Germany, and also in Bermuda. Wherever he went he made the acquaintance of the leading Entomologists and added to his stock of knowledge.

His first contribution to the *Canadian Entomologist* was in 1874, when he wrote No. 14 of a series of articles on "Some Common Insects"—"The Common Cockchafer," C. E. vol. vi. p. 67. His subsequent papers were the following: "List of Diurnal Lepidoptera collected in the Northwest Territories and the Rocky Mountains in 1883," C. E. xv., 221; xvi., 56, 224; xvii., 120; one hundred and twenty-six species were enumerated.

"Euptoieta Claudia," C. E. xvii., 60 (1885).

"Notes on three small collections of Diurnal Lepidoptera made in 1886." (These were made in Newfoundland, the Kamanistiquia River, Lake Superior, and Hudson Straits.) C. E. xviii., 204.

"Some notes on the genera Colias and Argynnis whilst alive in the imago state," C. E. xix., 166 and 230 (1887).

"Notes for collectors visiting the Prairies and Rocky Mountains," C. E. xxi., 57 (1889).

"Colias Ohione," C. E. xxi, 59.

He also contributed the following articles to the Annual Reports of the Society:—

"Some remarkable captures in Ontario," 18th Report, 1877, p. 21.

"On some of the collections in England and the German Empire," 22nd Report, 1891, p. 31.

"Insects collected in Bermuda during the winter of 1894," 25th Report, 1894, p. 25.

In addition to his love for Entomology, he took a great interest in philatelics, and formed a large and valuable collection of postage stamps. He was an accomplished musician and usually sang in the choir of the church that he attended; he was also a member of the Philharmonic Society of Toronto. He belonged to the Masonic Order, in politics was a strong Conservative, and in religion a member of the Church of England. His wife, who was a daughter of the late Edward C. Jones, of Toronto, died a little more than a year ago. The untimely death of Captain Geddes was no doubt hastened by her loss. They have left two little orphan girls, aged three and five years respectively.

The writer, who knew him intimately from his boyhood, deeply deplores his loss, and his grief is shared in by a very large circle of relatives and friends.

C. J. S. B.

MISS G. E. ORMEROD.

It is with deep regret that we record the death of Miss Georgiana Elizabeth Ormerod, of Torrington House, St. Alban's England, the elder sister of Miss Eleanor A. Ormerod, whose name as a distinguished Entomologist is known throughout the scientific world. After several months' of patiently borne illness, she passed away on the 19th of August last, full of piety and good works, and justly esteemed and loved by all who knew her. She and her sister were each other's constant companions and fellow-workers, and each sought the other's counsel and aid in carrying out any plan of work in which she was engaged. Miss G. E. Ormerod's special studies were botany and conchology, and in the latter department she formed a large and valuable collection of shells which she presented a few years ago, to the Natural History Museum at Huddersfield. She was highly gifted as a linguist, and acquired an excellent knowledge of French, Italian, Spanish and German, and was thus enabled to be of the greatest assistance to her sister in correspondence and the translation of foreign works of science. She is most widely known, however, by her remarkable talents as an artist, which were employed in the illustration of her sister's works, and in the production of a splendid series of diagrams in which are depicted a large number of the most important injurious insects in all their life-stages.

In addition to her scientific and artistic work she devoted much of her time and means to benevolent objects, and carried out for many years at her own expense a system of distributing books of an entertaining and instructive character amongst the working classes.

Women of such a type are rare, and we cannot but deeply deplore the loss of this eminent Christian lady, who died at an advanced age, full of good works, performed in a most unobtrusive manner; richly endowed with intellectual and artistic talents which she largely used for the benefit of others; always happy and cheerful in her daily domestic life; kind, hospitable and sympathetic: ready to help all who deserved her aid, and to give wise counsels to those who sought them from her.

To her sister—her life-long colleague—the loss is beyond what words can express. We can only venture to offer to her our heart-felt sympathy and our earnest wish that she may have grace and strength to endure so heavy a blow.

C. J. S. B.

ENTOMOLOGICAL LITERATURE.

THE GYPSY MOTH.—A report of the work of destroying the insect in the Commonwealth of Massachusetts, together with an account of its history and habits both in Massachusetts and Europe. By E. H. Forbush and C. H. Fernald.

This report, a handsome volume of nearly 600 pages, well printed and most copiously illustrated with chromolithographs, photogravures and wood cuts, gives a full account of the introduction of the now notorious "Gypsy Moth" into America by Leopold Trouvelot in 1868 or 1869, traces its history, and records the efforts which have been made to exterminate it by the State of Massachusetts up to the end of 1895. The spread of this insect for the first ten years was remarkably slow in the light of what we now know of its capabilities for harm. During that period it was not noticed by anyone but the introducer. The first extensive outbreak was in 1889, but for ten years before that it had given great annoyance to the people living in the part of the town of Medford, where it was first introduced. It had also spread and had gained a foothold in thirty townships without attracting public attention. Since that time its history is well known. In 1890 the first Gypsy Moth Commission was appointed and the work of fighting the pest was inaugurated. In February of the next year this commission was removed and another one substituted. On 12th of March Mr. E. H. Forbush, the present very efficient "Director of field work," was appointed, and on 18th June Prof. C. H. Fernald began his labors as entomological adviser. Since that time the work has been pushed on with great energy and the present valuable report is an outcome of the combined efforts of a practical, energetic manager and a careful, scientific entomologist. The two parts of this report prepared by the above named officers are quite distinct and form together a very complete treatise, not only upon the Gypsy moth, but upon the general principles which it is necessary to study when combatting any injurious insect. This carefully prepared report, therefore, cannot but be for a long time an indispensable book of reference for economic entomologists.

There are in this volume many things which will attract the attention of entomologists. Indeed, it is so full and there are so many different subjects treated of, that even to give the titles would take more space than is at my disposal. The first thing which will be noticed is the adoption of the generic name *Porthetria*. Articles of particular note deal with the studies made as to the methods of distribution of the Gypsy moth and the measures practised for the destruction of the insect in its different stages; spraying apparatus, and particularly the care of spraying machinery; methods of pruning, and some charming observations upon insect-eating birds.

The scientific work contained in Professor Fernald's report is of great value and contains a record of most painstaking and patient work. Probably one of the most interesting sections is that which deals with Natural Enemies, in which most excellent work has been done. Prof. Fernald has been aided in this work by efficient assistants, and the whole information so gained has been pieced together by a master hand.

With regard to spraying, some surprising results have been obtained. In the first place the caterpillar of the Gypsy moth seems to be little affected by applications of Paris green when applied of the strength ordinarily used for other mandibulate insects. Mr. Forbush says: "It became evident before the end of the season of 1891 that spraying, while reducing the numbers of the moth, could not be relied upon as a means of extermination, for many caterpillars survived its effects."

The following conclusion on page 139 will show entomologists that the matter of controlling mandibulate insects, by means of active poisons, is still a fertile field for careful work, in which useful and laurel-bearing results are still to be reaped:

"Every effort was made during the spraying season to determine why the results of spraying were not uniform and satisfactory. The feeding caterpillars were watched day and night by many observers. The spraying was most carefully superintended and the conclusion finally arrived at was that, under ordinary conditions, spraying with Paris green for the Gypsy moth was ineffective and unsatisfactory."

Paris green was on the whole the most fatal insecticide, and when used in the proportion of one pound to 150 gals. of water did not burn foliage, but with larger proportions did considerable harm. The injury developed so rapidly that within a short time the leaves were all killed and the surviving larvæ had to go elsewhere to feed. "Therefore, a strong Paris green mixture had little better effect than a weak one. Lime was then used with the Paris green with a view of neutralizing the burning, but considerable injury to the foliage still continued."

Probably one of the most remarkable facts discovered by the entomologists is related by Professor Fernald on page 476, where he says: "One interesting result obtained from the analysis of the different stages of the Gypsy moth, made in 1893 and 1894, is that pupæ and imagoes from caterpillars which have been reared on leaves sprayed with Paris green or arsenate of lead, may contain arsenic in recognizable quantities. Several pupæ and a few female imagoes obtained under these conditions, when subjected to chemical analysis gave ample evidence of the presence of arsenic in their bodies. This shows that the presence of arsenic in the pupa may not materially interfere with the processes involved in the development of the imago. Since, as has been repeatedly demonstrated, moths reared from poisoned larvæ are capable of reproduction, it is also evident that the arsenic contained in their bodies does not injure the reproductive function."

With reference to the amount of arsenic which could be consumed by some of these caterpillars, and yet leave them "normally active and healthy," it was found that some of them had in their bodies in proportion to their weight, an amount equivalent to 12½ times the fatal dose for an adult human being, in proportion to the weight of the latter.

The work of the Gypsy Moth Committee has been criticized, examined and studied by practical men who were entomolgists and others who were not. As far as I can learn, the general verdict is that excellent work, and, under the circumstances, remarkably so, has been done. The insect is not exterminated, it is true; but there seems every reason to hope, judging from what has been done and the behaviour of the species in other countries where it was once alarmingly abundant, that this is possible, if money is supplied and if it is given at the time when it can be made use of to the best advantage. On pages 38 to 93 of the report will be found an instructive account of the constant efforts of the Committee to get funds to carry on the work properly, and year after year it was the same story of reduced, and what was almost worse, delayed appropriations, resulting in the necessity of modifying the whole plan of work arranged for the year, so that instead of making vigorous efforts for the extermination of the insect, and fighting it at the time this could be most effectively done—early in the season, when the caterpillars were small—all that could be done was to try and prevent the further spread of the enemy from the localities known to be infested. The appropriations which have been made for this work are considerable, about $525,000 up to the present time, and this amount would certainly have produced far better results, could the Committee have obtained the grants at the time they required them, so that they could have begun the work early in the season and continued employing, from year to year, those assistants who had been taught, at an expense of much time and trouble, what was required of them. J. F.

REPORT OF OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEAR 1895, WITH METHODS OF PREVENTION AND REMEDY. Nineteenth Report, by Eleanor A. Ormerod, F. R. Met. Soc., etc.

This splendid report fully sustains the high standard of excellence which has characterized Miss Ormerod's previous publications. The preface shows that the unusual and prolonged low temperature of the winter of 1894-95 had apparently but little affected the insects which it might be supposed to destroy.

The following pests are treated of in separate chapters: Apple, *Smerinthus ocellatus*; bean, *Bruchus rufimanus* and *B. fabæ*; cabbage, *Ceutorhynchus sulcicollis*; corn and grass, *Charæas graminis*, *Cetonia aurata*, *Phyllopertha horticola*, *Melolontha vulgaris*, *Rhizotrogus solstitialis*, *Tipula muculosa* and *Oscinis frit*; gooseberry, *Bryobia prætiosa*, *B ribis* and *Nematus ribesii*; mangolds, *Aphis rumicis*, *Silpha opaca* and *Atomaria linearis*; orchard caterpillars, *Cheimatobia brumata*; pine, *Astynomus ædilis* and *Retinia buoliana*; plum, *Scolytus rugulosus*; strawberry, *Harpalus ruficornis*, *Pterostichus madidus* and *P. vulgaris*; turnip, *Helophorus rugosus*.

The ravages of the bean weevil appear to have been serious, and those of the ground beetles, upon the strawberry, have been more extensive than in previous years. Ninety-three pages are occupied with the discussion of the above mentioned insects, while fifty are allotted to "Flies injurious to horses, cattle," etc. These chapters are exceedingly interesting, and several species of Hippoboscidæ, Tabanidæ, and Œstridæ, which are very annoying and injurious to domestic animals, are fully and clearly discussed. In connection with the account of the attacks of the Forest Fly, *Hippobosca equina*, are given two magnificent plates showing upper and side views of the foot of this fly, the tarsi of which are so modified as to enable it to secure a most firm grip on the hairs of the animal upon which it alights. The report concludes with a chapter on Deer and Dog Ticks, very troublesome mites belonging to the Ixodidæ. W. H. H.

BRITISH BUTTERFLIES, by J. W. Tutt, F.E.S., London: George Gill & Sons, 1896. Pp. 469. (Price 5s.)

It is only a few months since we spoke in terms of commendation of Mr. Tutt's Manual of the British Moths, and now we have before us an even better work on the butterflies by the same industrious author. About one-fourth of the book is taken up with the general subject, presenting a series of chapters on the four life stages of butterflies, their variation and its causes, hibernation and æstivation, classification, collecting, arranging and preserving specimens, and the inflation of larvæ These are written in the author's pleasant, easy style, with which his previous works have made us familiar, and convey much information of interest to butterfly-hunters everywhere. We are glad to observe that he insists very strongly upon the importance of labelling specimens with the place and date of capture, though the English mode of using short pins and setting the specimens low down makes this a matter of difficulty.

The descriptive portion of the work is excellent and much more complete than that of any manual of British butterflies that we have met with. In the case of each species there are given the English and scientific names, reference to the plate where it is figured, synonymy and bibliography, a concise description of the imago, a paragraph on "variation" in which are mentioned any known aberrations, forms of varieties, as well as sexual distinctions, descriptions of the egg, larva, pupa, notes on the time of appearance, habitat and geographical distribution. Thus it will be seen that proper regard is paid to the whole life history of the insect and that the author does not confine his attention to the imago alone. The plates (uncolored) on which each species is depicted are admirable, and should enable any collector to identify his specimens without difficulty; there are also a considerable number of wood cuts throughout the text.

In the arrangement of species the author begins with the "lowest"—the Skippers, Hesperidæ—and proceeds upwards to the Satyridæ, among which he strangely places "the Purple Emperor," *Apatura iris*. His classification, a thorny subject which we do not propose to discuss here, may thus be considered fully "up to date."

To our readers in the British Isles and to those who have collections of British butterflies, we heartily commend this excellent manual. We only hope that it may not be very long before we have some hand-book equally good dealing with the butterflies of Canada.—C. J. S. B.

PRELIMINARY NOTES ON THE ORTHOPTERA OF NOVA SCOTIA, by Harry Pier. Transactions of the N. S. Institute of Science, vol. ix., 1896.

So little attention is paid to Entomology in the Maritime Provinces that we gladly welcome this contribution to the subject and are much pleased that Mr. Piers intends to devote some years to the study of the order Orthoptera. The paper before us gives some very interesting notes on the habits and range of fourteen common species of cockroaches, crickets and locusts, and describes more at length the ravages committed by *Melanoplus atlanis* on Sable Island, a hundred miles off the coast of Nova Scotia in the Atlantic Ocean.—C. J. S. B.

INSECT LIFE.—A short account of the classification and habits of insects, by F. V. Theobald, M.A., F.E.S.. London: Methuen & Co. Pp. 235. (2s. 6d.)

Under the title of the "University Extension Series" the publishers are issuing a number of books on historical, literary and scientific subjects, which are intended to be both popular and scholarly. We have not seen any of the other works of the series and cannot, therefore, comment upon them, but the book before us seems hardly to come up to the expectations one would naturally form of a manual intended for use in preparation for "University Extension" lectures. The descriptive portion is meagre and will afford a student a very vague idea of the insects belonging to the different orders. It is satisfactory, however, to find in an English publication some attention paid to Economic Entomology and the application of the insecticides, which are in common use here. The book is neatly printed (though we have noticed several misprints in the spelling of names) and is illustrated with over fifty wood cuts.—C. J. S. B.

CRITICAL REVIEW OF THE SESIIDÆ FOUND IN AMERICA NORTH OF MEXICO, by William Beutenmüller, pp. 111-148, Bull. Am. Mus. Nat. Hist, VIII., 1896.

The writer of the present brief notice of this excellent paper on the *Sesiidæ* desires to call attention to the very careful work of Beutenmüller on the clear-wings and the necessity for this work which has arisen from the uncritical publications of preceding authors. It appears, for instance, that our *S. lustrans*, a species well distinguished by antennal peculiarities, has been five times the subject of new descriptions by the late Mr. Hy. Edwards, whose species are very properly reduced, as appears from Beutenmüller's studies. The name hitherto used for this species itself must, it seems, give way to *bassiformis*, Walk., described from a type in poor condition. Beutenmulle:

is quite correct in calling attention to the particular necessity in this group for good material from which to describe. The want, perhaps, of such material led Mr. Edwards to describe *S. rutilans* six times over. A large number of sexual determinations by Mr. Edwards are corrected by Mr. Beutenmuller, so it seems hardly possible for anyone to have worked with less judgment. The list of the clear-wings in the New York Check List was drawn up, with the rest of the list, by the writer of the present lines, who at the time merely sent the last proof to the late Mr. Hy. Edwards for his revision. Mr. Edwards added, in explanation, the two foot notes on page 12 and signed these, and made one or two changes in his names for genera on page 11. The writer is also responsible for the list of the clear-wings, since he originally wrote the same, and not Mr. Edwards. The explanation is here given, as the list has been erroneously alluded to as the work of Mr. Edwards. In the Philadelphia list the New York list is generally copied, but *lustrans* is wrongly given to Mr. Hy. Edwards, and an implication is conveyed in the preface that Mr. Hy. Edwards was the author of the lists of the clear-wings, which is here corrected. The writer trusts that Mr. Beutennmuller will continue his studies and that lepidopterists generally will help him in every possible manner. It is a matter of great satisfaction that Mr. Beutenmuller's timely work is also of such good quality. The writer would merely reclaim his *Sesia pictipes*, which is also given to Mr. Hy. Edwards, on p. 134, and draw attention to the excellent description of the habits of this species given by the late Dr. Bailey in the pages of the American Entomologist.

A. RADCLIFFE GROTE, A. M.

A LIST OF THE BUTTERFLIES OF SUMATRA, with special reference to the species occurring in the north-east of the Island. By L. de Nicéville and Hofrath Dr. L Martin. Calcutta. Reprinted from the Journal of the Asiatic Society of Bengal, 1895.

This list of seven hundred and fifty-six species of butterflies taken in a limited portion only of the great Island of Sumatra, gives one some idea of the wealth of the insect fauna in tropical regions. In a very interesting introduction the authors give a brief description of the Island, which is nearly as large as France and is bisected by the equator, and relate the difficulties that have to be surmounted in the formation of a a collection of its butterflies, which can only be effected by employing natives, who have first to be taught and trained for the purpose. Dr. Martin lived for thirteen years on the Island and has thus been enabled to add very interesting notes on the distribution, scarcity or rarity, habits, season of occurrence, etc., of a large number of species. One may, therefore, open the list anywhere and find not a mere record of names, but highly interesting details regarding the butterflies. As might naturally be expected, the preparatory stages of the majority of the species are as yet unknown.

C. J. S. B.

A LIST OF THE BUTTERFLIES OF SIKHIM, by Lionel de Nicéville, F. E. S., etc. Calcutta: from the Gazetteer of Sikhim. Printed at the Bengal Secretariat Press.

Probably no part of the great British Empire of India and its tributary States has been so fully explored by the collectors of butterflies as the country of Sikhim, which includes the famous health resort of Darjeeling, about 7,000 feet above the sea, on the slopes of the Eastern Himalayas. Consequently the author is able to record in this list no less than six hundred and thirty-one species, which he considers a near approach to the maximum number that can be discovered. Certainly it is a goodly number, and one hard to be realized by a dweller in these northern and much less luxuriant regions. And what splendid creatures they are, with their gorgeous colouring and infinite variety of shapes and hues. Nearly fifty species of Papilios alone are recorded, and more than one hundred and fifty Lycænidæ, the greater number of which belong to genera that are entirely unknown to us here.

C. J. S. B.

MONOGRAPH OF THE BOMBYCINE MOTHS OF AMERICA NORTH OF MEXICO, including their transformations and origin of the larval markings and armature. Part I., family 1, Notodontidæ. By ALPHEUS S. PACKARD. National Academy of Sciences, Vol. VII., 1895 (received May 11th, 1896); 292 pages, 49 plates, and 10 maps.

Dr. Packard's long promised monograph has at length appeared. The copious text is divided into ten sections: I., Introduction; II., Hints on the mode of evolution of the bristles, spines, and tubercles of Notodontian and other caterpillars; III., On certain points in the external anatomy of Bombycine larvæ; IV., On the incongruence between the larval and adult characters of Notodontians; V., Inheritance of characters acquired during the lifetime of Lepidopterous larvæ; VI., Geographical distribution of the American Notodontidæ; VII., Phylogeny of the Lepidoptera; VIII., Attempt at a new classification of the Lepidoptera; IX., A rational nomenclature of the veins of the wings of insects, especially of the Lepidoptera; X., Systematic revision of the Notodontidæ, with special reference to their transformations.

Most of these have previously appeared as separate articles, as the reader will recall. The life-histories are given as fully as our present knowledge will allow, much of this knowledge being due to Dr. Packard's own labours. The plates illustrating them are beautifully coloured, the early stages highly magnified. These plates must be seen to be appreciated.

A few remarks in criticism of the memoir will not be understood to imply a lack of appreciation of its many valuable features. In general the synoptic tables of subfamilies, genera, and species are poor and uncritical. They are no improvement over those of the author's monograph of Geometridæ, to which the same criticism applies. In all the figures of larvæ the setæ are imperfectly shown, and their number and position are not to be relied upon. I corrected for Dr. Packard a number of the plates in this respect, but the corrections were necessarily made from memory and on general principles, and there is not a figure which has the authority of a careful copy from nature. Even the special figures in the text are often grossly erroneous; *e. g.*, figure 9, on page 63, where the back and side views of the same larva are shown as different. Dr. Packard also fails generally to describe the arrangement of the setæ in the text.

The classification of the Lepidoptera which is used is original with the author. It has been already presented in the *American Naturalist*, where I have had occasion to notice it. In rejecting the classification of Prof. Comstock, the author argues that the frenulum is of small value in classification, because both frenulum and jugum are present in some Jugatæ, and the frenulum is absent in some Frenatæ. While we may admit this argument for what it is worth, it seems that Dr. Packard entirely misses the great cumulative force of the evidence adduced by Prof. Comstock and others for these suborders. Classifications founded on the venation alone [Hampson], the wing scales [Kellogg], and the antennæ [Bodine] give the same suborders. I have also shown that the larval characters do not support Dr. Packard's view. But Dr. Packard gives no weight to larval characters, in spite of the implication in the title.

HARRISON G. DYAR.

MISSOURI BOTANICAL GARDEN. SEVENTH ANNUAL REPORT, 1896.

Very few reports are more eagerly looked for every year by those who are lucky enough to secure copies than Prof. Trelease's report on the Missouri Botanical Garden and the Henry Shaw School of Botany at St. Louis, Mo. This report contains not only the Director's annual statement on the condition of the Garden and its finances, but also valuable monographs on different genera of plants. In the present volume we find the following: I. *The Juglandaceæ of the United States*, by Prof. Trelease; II. *A Study of the Agaves of the United States*, by A. Isabel Mulford, and III. *The Ligulate Wolffias of the United Stvtes*, by C. H. Thompson. A feature of all these annual reports is the magnificent illustrations.

In addition to the above, there is the report of a speech delivered at the sixth annual banquet, by President Henry Wade Rogers, of the North-west University, on The Value of a Study of Botany, and a catalogue of the "Sturtevant Prelinnean Library" the greater part of which was presented to the Botanical Garden by Dr. E. Lewis Sturtevant, in 1892.

One very notable omission from the present volume which we much regret is the printing of the Annual Flower Sermon. Last year it was delivered by the Rt. Rev. W. C. Doane, Bishop of Albany.

The first annual event provided for in his will by Henry Shaw, the good man who founded this garden for the enlightenment and happiness of his fellow men, was "The preaching of a sermon on the wisdom and goodness of God, as shown in the growth of flowers, fruits and other productions of the vegetable kingdom.". A lovely poem in prose for the perusal of which by his friends, the writer's copy of the 1893 report is in constant use, is a sermon preached by the Rev. Cameron Mann, from the text "Consider the lilies of the field." This sermon, from a literary standpoint, is charming, and certainly helps to carry out the wise wish of the benevolent founder to inculcate in all a thankful spirit for the many lovely things in the vegetable kingdom which we find strewed with no niggard hand along our walk through life, making our own journey more beautiful and, it is hoped, our friends happier from contact with us.

J. F.

Economic Entomology, for the farmer and fruit grower and for use as a text book in agricultural schools and colleges; by John B. Smith, Sc. D. Philadelphia: J. B. Lippincott Co., 1896. [Price $2.50]

It is rather remarkable, when the self-evident importance of the science of Economic Entomology is considered, that until Prof. Smith issued his excellent manual, which has just appeared under the above title, there was no one American book which a farmer could consult to find the names and proper remedies for the common crop pests which would come regularly before him in a year's working of his land. The author in his long experience first as a member of the staff of the " United States Entomologist at Washington, and subsequently as State Entomologist of New Jersey," has had great opportunities of becoming thoroughly informed on his subject. That he has made the best use of these opportunities, is evidenced by the excellent book which he has now produced. The best way to test anything is to use it. Thus if anyone wishes for information upon anything within the limits of Economic Entomology, the subject of Prof. Smith's book, as, for instance, some one of the regularly occurring insect enemies of crops, *e. g.*, cut-worms, white grubs, canker worms, the Colorado potato beetle, plum curculio or tussock moth, etc., let him turn it up in the index of this work and he will be referred to a clear and concise account of the insect and its habits, together with recommendations as to the best remedies. The identification of the different species is made easy by a profusion of remarkably good illustrations. The whole book, including the index, consists of 481 pages, while the number of illustrations is no less than 483, all of which are unexceptionable if a mental reservation may be allowed as to the three plates of Bumble-bees and Bee flies Nos. 398, 464, and 473, taken evidently from photographs. It seems a pity that these plates should have been included in this work on Economic Entomology. The arrangement of the book, for ease of reference, is well planned and well carried out, the objects the author had in view, as explained in the introduction, being adhered to in a most satisfactory and complete manner. Part I. consists of eight short chapters on the Structure and Classification of insects. Part II. the insect world, which forms the bulk of the book, is a systematic treatment of the various common injurious insects in their natural orders. This portion is particularly well balanced, enough space being devoted to each species treated of to satisfy the inquirer, without, as is sometimes the case, giving undue importance to some at the expense of others. Part III. treats of insecticides, preventive remedies, and machinery. This work cannot fail to prove of great value to the farmer and fruit grower, as well as to the amateur gardener and student of insect life, who will find in it an authoritative book of reference of small size but comprehensive and easy to consult.

J. F.

HOUSEHOLD INSECTS, (U.S. BULLETIN NO. 4. NEW SERIES.)

During the year 1896 several most useful publications were issued from the United States Division of Entomology under the direction of Dr. L. O. Howard. Of particular interest to the general public was Bulletin No. 4, entitled "The Principal Household Insects of the United States." The main part of the volume is prepared by Dr. Howard and his assistant Mr. C. L. Marlatt, and at the end is a chapter by Mr. F. H. Chittenden on "Insects affecting cereals and other dry vegetable foods." To entomologists, who know the literary and scientific work of these gentlemen, it is only necessary to say that this volume is up to, or perhaps even a little above, the usual excellent standard of the papers issued from the U.S. Division of Entomology at Washington. A very few minutes' examination of the different articles in Bulletin 4 will convince anyone of the extreme value of this concise, practical treatise on all the commoner insects which are likely to be found troublesome inside houses. It is almost impossible for one who has made a specialty of entomology to speak in moderate terms of these publications. There is nothing to compare with them published in any other country. When we consider the matter treated of, and the practical way in which it is presented, the manifest care to secure accuracy of statement, the exquisite work of the artist as well as the arrangement and general get-up of the pamphlet, one is tempted to use so many superlatives that any opinion expressed might be thought to be unduly biassed.

A special feature of value in this publication is that it is entirely made up of original American observations, most of them prosecuted in the Division of Entomology, and, as is pointed out by Dr. Howard in the introduction, the very curious but not unexpected condition of affairs was shown in the preparation of this bulletin that of some of our commonest insects the life history is not known with any degree of exactness. The insects treated of are such as are found in houses and which either annoy the occupants by their direct attacks or are injurious to household goods and provisions. These are described in eight separate chapters. J. F.

MISS ORMEROD'S TWENTIETH ANNUAL REPORT, 1896.

One of the pleasantest events of the year for the economic entomologist is the arrival of Miss Ormerod's Annual Report. The liberality with which the distinguished authoress distributes these treasuries to students and public institutions all over the world brings them within the reach of all who may wish to profit by their perusal.*

It is seldom that any series of publications upon a single subject can show year after year such a steadily maintained, and even gradually increased, interest, as has been the case with these reports—new infestations of crops are being constantly investigated, old attacks restudied, and additions made to the previously recorded methods of treatment or prevention. It matters little in what part of the world a student may be located, he will always find something of value which may be profitably applied to his special work in fighting against the crop pests of his own country. The present report is no exception to the general rule. We congratulate our highly esteemed corresponding member on the practical and serviceable manner in which the subjects she treats of are presented to the public. As a writer in the *Queen* newspaper of late date says, "Miss Ormerod's work does not consist in playing with entomology, but is true, valuable, practical, scientific observation, and she enjoys the proud privilege of being regarded as one of the most reliable scientific observers."

On opening the report one is sadly reminded by the frontispiece, an excellent likeness of the late Miss Georgiana E. Ormerod, of the irreparable loss the authoress has suffered in the recent death of her much loved and highly talented sister, who has been her life-long companion and able assistant in the grand work she has done for economic entomology in England. The late Miss Ormerod was a naturalist of no mean standing and possessed remarkable talents as an artist. She is well known as the authoress of the magnificent series of thirty colored diagrams of insects injurious to farm crops. These are thirty inches long by twenty wide, and are most suitable for use in a class room or at farmers' institute meetings. In the preface of the report the sad event referred to above is touchingly and fittingly alluded to with a reference to the obituary notice by Dr. Bethune which appeared in the *Canadian Entomologist* for November last.

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*These reports are also for sale by the publishers, Simpkin, Marshall & Co., London, at the almost [illegible]minal price of 1s. 6d.

Among the various short monographs contained in this report of 160 pages many are of interest to Canadian farmers and fruit-growers either from the identical species occurring both in England and Canada, or from a similarity in habits between allied forms in the two countries.

Codling Moth: This is one of the yearly recurring troubles of the fruit grower to which most of the damage to apples may be laid. English experimenters do not even yet seem to have mastered the spraying of apple trees for the prevention of injury by the codling moth. The remedies are given by Miss Ormerod as follows: "Our only really available remedies against this infestation appear to lie 1st in destroying infested apples; 2nd in trapping the caterpillars and destroying their shelters; and 3rd on being well on the alert at the time of the blossoming of the apple, and by careful spraying preventing the very beginning of the attack." In this country the recommendation for the best remedy would be: "Spray with 1 lb. Paris green and 1 lb. lime in 200 gallons of water within a week after all the blossoms have fallen."

Beet Carrion Beetle: We have occasionally in the North-West Territories a rather rare attack upon vegetables such as squashes, spinach, etc., by the larvæ of one of the carrion beetles *Silpha bituberosa.* In England a very similar species has been the cause of serious damage to mangolds, and last season when other food failed attacked potatoes. The carrion beetles feed both on vegetable and decaying animal food. It is suggested by a correspondent to attract the beetles and larvæ from the crop by putting about the infested fields "a few wild pigeons, rooks, hawks or similar *vermin.*" (*Sic.*) The ignorant farmer in England, as well as in other parts of the world, "generally shoots in spring" every hawk he can see. In this country the remedy which would first suggest itself would be dusting the crop with land plaster and Paris green (50 lbs. to 1).

Leather Beetle: An interesting account is given of an attack by *Dermestes vulpinus.* Large numbers of beetles were found in a building where bones had been stored for six or nine months for the manufacture of manure, and not only the bones were honeycombed, but also the posts and floors of the building over them, which were seriously injured by the larvæ, when full-grown, boring into the wood to pupate. Reference is also given to another similar occurrence near Sheerness, in Kent, which was upon even a larger scale than the one treated of by Miss Ormerod. This article is illustrated by excellent figures of the beetle and its various stages, as well as a portion of a perforated bone and a piece of honeycombed wood.

White Cabbage Butterflies: Under the head of cabbage two species of *Pieris* are treated, and powdery dressings are recommended as fresh lime, soot and sulphur. The highly reprehensible practice of using Paris green upon cabbages is referred to, but Miss Ormerod wisely says she could not take on herself the responsibility of advising the treatment, more especially as the feeling against it might probably ruin the sale of the cabbage. There is no doubt of the truth of this last statement. There is never a season passes that instances do not come under the notice of the writer of people expressing fear of buying cabbages lest they may have been poisoned with Paris green. In addition to this the use of such a virulent poison is quite unnecessary. Pyrethrum powder mixed with three or four times its weight of common flour and kept for twenty-four hours in a tightly closed vessel is even more quickly fatal than Paris green, killing every caterpillar the powder falls upon, or upon which the infusion of the powder may run when it has been wetted by dew or rain, and further, this powder is not poisonous to the higher animals.

Croton Bug: An occurrence of this well-known guest at hotels and other large buildings heated with steam, is spoken of. The usual remedies adopted in this country as powdered borax and the many brands of pyrethrum powder are mentioned, and "stoving" with sulphur is given a prominent place under remedies.

DEER FOREST FLY: For some years Miss Ormerod has made a special study of the *Hippoboscidæ* or Forest flies, and another chapter of her most interesting observations on these little-known insects is given in the present report, with excellent figures of the common Forest fly and the Deer Forest fly.

EARWIGS: The injuries of earwigs in hop gardens and to mangolds, swedes and turnips, likewise to apple blossoms, have been serious in 1896. The old method of trapping the insects in inverted flower pots or tin pots containing a wisp of straw has given good results; also beating them at night on to tarred boards.

THE HOUSE FLY (*Musca domestica*, L.): One of the most interesting monographs in this report, at any rate to the general public, is an account of the troubles caused by the common house fly. The life history of the insect is treated of at considerable length with quotations from the several authors who have written on the subject of "flies" and a statement as to the serious annoyance by house flies in India upon horses. Dr. Spooner Hart, V.S., of Calcutta, sent numerous specimens of a fly which was examined carefully by specialists and found to be true *Musca domestica*. He says: "March 24th. It is the worst pest the horse has here, and at this time of the year it exists in thousands especially in the suburbs. It attacks in great numbers the eyes principally, and is constantly flying off and coming back all day long to the same site. This causes great irritation and inflammation, which, being continued day after day and neglected, will lead to blindness, disfiguration of the eyes and ulceration of the face.

"Our hackney carriages (cabs) here are drawn by wretched half starved ponies fed principally on grass, out all day exposed to the sun, stabled in filthy holes and are most disgracefully treated and neglected. Dozens of these unfortunate creatures are blind from irritation set up by these flies, and present huge ulcers on either side of the face just below the eyes, the result of constant lachrymation and irritation of the flies. The eyelids are thickened and averted and the appearance is awful. The flies are dreadfully persistent, and will not be shaken off." Under the head of Prevention and Remedies it is pointed out that as house flies as far as is actually known for certain, breed wholly in horse manure, much may be done to lessen the numbers by keeping stables clean and removing as quickly as possible all horse droppings and getting them into the land as soon as convenient. Further, as many observers believe that house flies breed also in other decaying matters it is advised to pay special attention to garbage thrown into ash pits.

With regard to the attacks of flies to horses' ears, eyes, etc., Dr. Hart writes that a carbolic wash when freshly applied will keep the flies away. Horses in India are also protected by eye fringes, made of hanging white cords which cover the eyes and prevent the flies from settling. The irritation to horses described above reminds us of the distressing accounts given by travellers in Egypt of the diseased condition of the eyes of the Egyptian beggars, particularly of babies and children, from the irritation caused by flies. The prevalence of ophthalmic troubles would suggest the frequent spread of these diseases by flies, the infection being carried from person to person.

As to the manner in which these sores are made Miss Ormerod says as follows: "Several other kinds of flies are very commonly to be found in our houses, including *Stomoxys calcitrans*, sometimes called the "stinging fly," which can give a painfully sharp prick by means of a needle-like proboscis. From these the house fly can be distinguished by its having not a sharp pricker, but a soft proboscis adapted for suction, but incapable of penetrating the skin, so that when these insects trouble man and animals it is only to imbibe their perspiration. But the various other flies which commonly pass under the name of "house flies" much resemble them in many particulars of their life-history, and speaking generally of these "flies" it is obvious that even of those which do not sting, where the foot has the "pads" covered with hundreds of hollow tubes secreting a viscid fluid by which they adhere to the smoothest surface, and the organs used in taking food consist of minute formations called teeth by which the surface of the food is rasped, and thus new surfaces exposed to the action of the moisture of the fly's mouth, that it is not surprising that delicate parts, such as the surroundings of the eye, should suffer grievously, where, as in hot countries, they are buried under the constantly attacking masses of the pests."

Two simple devices are explained, one for catching flies, wasps, etc., out of doors in a wholesale way, the other for clearing a room in summer when flies frequently swarm into houses in annoying abundance. For the capture of flies in gardens Miss Ormerod advises the use of two square hand-lights, one set on the top of the other. The finger hole at the top of the lower one allows the flies to go up into the upper one, of which the hole is closed with moss or other material, and the lower one is raised up from the ground on bricks, with a bait of some attractive substance placed below. The flies after feeding rise up and gain access through the hole at the top to the upper light where they collect in thousands that soon die from the heat of the sun.

To keep flies out of dwelling houses Miss Ormerod tells of a plan contrived by her late sister, Miss Georgiana Ormerod. It is to close the lower sash of the window, then draw down the upper sash so as to open it about a foot at the top. Next draw down the calico rolling blind so that the flies are inclosed between the blind and the glass panes of the window, when, following their natural instinct, the flies rise, and when they arrive at the opening to the fresh air outside, out they all go.

A similar plan to the above has been practised in the dining-room of one of the hotels at Ottawa for some years, and has given great satisfaction.

LEAFAGE CATERPILLARS: In this chapter several leaf-eating caterpillars are treated of, together with the well tried insecticides, Paris green and kerosene emulsion. It is evident that through Miss Ormerod's instrumentality these valuable remedies are gradually becoming better known and more generally used by English orchardists.

MEDITERRANEAN FLOUR MOTH: We regret to read that this most injurious insect which was first noticed as mischievous in England in 1887, is now thoroughly established as a perfect pest in any roller flour mill where it once gets a footing, and also is to be found in bakeries, or the like places where the flour, on which its caterpillars feed, is present; and consequently now is in the course of unchecked spread, which has given the infestation thorough establishment. No new methods of treating the insect are spoken of; but an incidental mention is made to an important matter, *i.e.* the spoiling of flour by fumigating with sulphur, showing the necessity of knowledge and care in making use of this remedy. In Canada, even without any care on the part of millers, this infestation is of rare occurrence, the spread and increase of the insect over most of the Dominion being prevented or rendered easy of control by the low winter temperature, to which from time to time mills can be subjected.

ONION SICKNESS.—This attack due to the Stem Eel-worm (*Tylenchus devastatrix*) has never, so far as I am aware, been observed in Canada; but may at any time appear. The reasonable remedy proposed by Miss Ormerod should, however, be adopted for all vegetables showing disease. This is to destroy carefully by burning everything which shows a diseased growth, and on no account throw it on a manure pile to be put back again on to the land.

THE PEAR LYDA or Social Pear Saw-fly is of particular interest from the almost identical appearance and habits of the species with those of a Lyda found in great abundance last July in southern Manitoba on plum trees in the gardens of the Mennonites. Whole trees were seen, upon which nearly every leaf was seared and skeletonized. The foliage of large branches was frequently webbed tightly to the twigs, forming a tent containing scores of the curious false caterpillars The remedy of spraying the trees early in June with Paris green would certainly have saved the trees.

PEAR AND CHERRY SAW-FLY (*Eriocampa limacina*)—The Pear slug every year does much harm in Canada. This is almost invariably from the fruit grower's neglect. These caterpillars can be easily controlled by spraying or dusting with Paris green.

SURFACE CATERPILLARS (the cutworms of this country) did much damage in 1896. The chief point of interest is a trial of a mixture of nitrate of soda and salt (proportions not given) hand sown after hoeing between the rows and between the roots—at the rate of about 3 cwt. per acre. The results of the trial seem to justify a further test of this remedy which at any rate would invigorate and help the remaining plants to make a vigorous growth.

CADDIS WORMS were troublesome in beds of watercress and did considerable damage. This plant is cultivated in shallow canals with running water and is grown in large quantities to supply the city markets. The foliage is destroyed by the encased larvæ of several species of water flies which crawl nimbly about the plants. The most successful remedy was found to be to flood the beds deeply and then disturb the Caddis worms by passing the backs of wooden rakes very thoroughly over the plants. The worms let go their hold of the plants and rise to the top of the water and are carried off down the stream past the beds.

The above brief references are merely to those articles in this valuable report which are thought to be of direct interest to us; but there are many other subjects treated which may at any time demand our attention. The great charm of Miss Ormerod's reports is that she does not theorize and when reading them there is always an overwhelming feeling of confidence that any observation or investigation recorded is put down absolutely as she saw it.

J. FLETCHER.

THE REV. THOMAS W. FYLES, F.L.S.

We have much pleasure in presenting to our readers the excellent portrait of our colleague, the Rev. Thomas W. Fyles, who has been for many years an active member of the Entomological Society of Ontario. Though living at South Quebec, he has regularly attended the annual meetings at London, travelling many hundreds of miles in order to do so, and has invariably delighted those present with his excellent papers. He was a member of the Council from 1882 to 1888, when the change in the Act of Incorporation required the directors to be resident within certain districts of the Province of Ontario. Three times he has represented the Society as their delegate to the Royal Society of Canada at Ottawa, and he has been a member of the Editing Committee of the *Canadian Entomologist* since 1889.

While filling the arduous position of Chaplain to the immigrants landing in Canada, under the auspices of the Society for Promoting Christian Knowledge, he devotes any spare moments that he can get to the study of entomology. He has succeeded, with an energy and enthusiasm worthy of admiration, in forming an extensive collection of insects and acquiring a knowledge of the science beyond what is ordinarily met with. That he may long continue to carry on his excellent work, both in his official position and in his scientific pursuits, is the hearty wish of all his friends.

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OF

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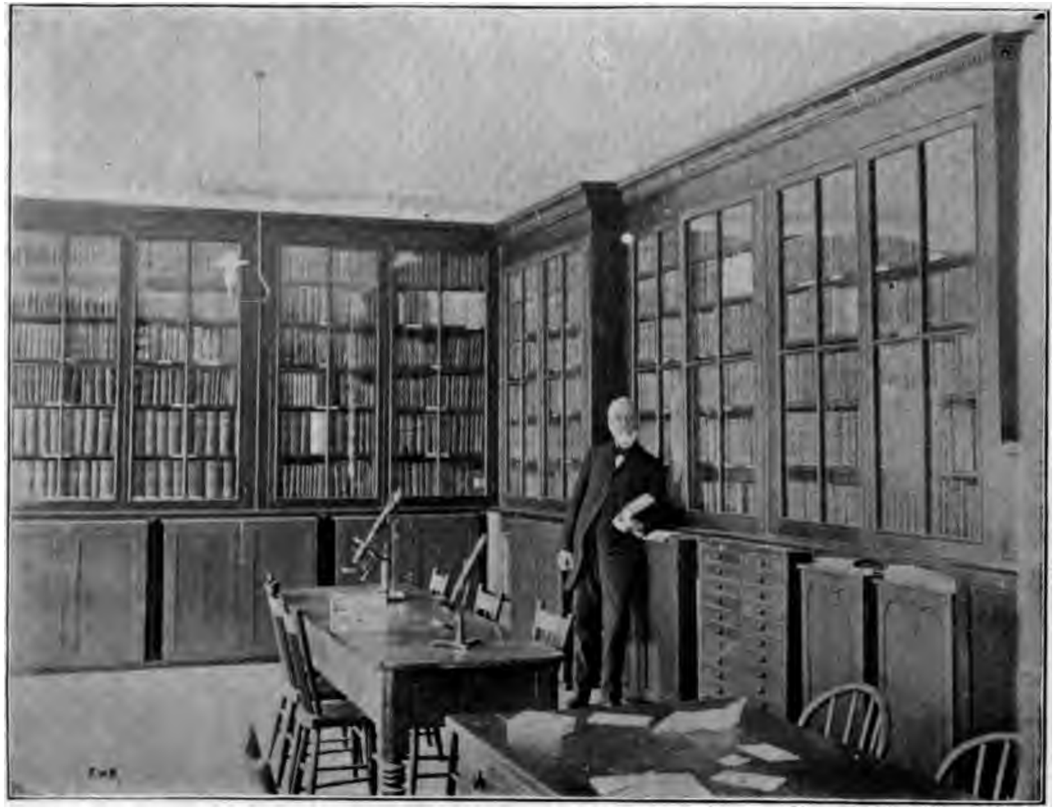
JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.

Dominion Entomologist and Botanist, President of the Entomological Society of Ontario, 1886-88.



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TWENTY-EIGHTH ANNUAL REPORT

OF THE

ENTOMOLOGICAL SOCIETY OF ONTARIO

1897.

To the Honorable John Dryden, Minister of Agriculture :

SIR,—I have the honour to transmit to you the twenty-eighth annual report of the Entomological Society of Ontario. It contains a full account of the proceedings at our thirty-fifth annual meeting, which was held in the City of London, on the 12th and 13th of October last, for the election of officers, the reading of papers and the transaction of the general business of the Society. The report includes the financial statement of the Treasurer and the reports of the various sections and departments of the Society, as well as the papers read and addresses delivered during the course of the meeting. Much attention was given to the alarming outbreak of the San Jose Scale insect in various parts of Ontario, and a valuable paper on the subject is included in this report.

The *Canadian Entomologist*, the monthly magazine issued by the Society, has now completed its twenty-ninth volume, and begun the publication of the thirtieth ; this is a record unequalled by any other monthly publication on entomology that has appeared in North America. The recently completed volume will be found to contain a large number of highly scientific and valuable papers contributed by the most eminent students of this department of science in Canada and elsewhere.

I have the honor to be, Sir,
Your obedient servant,

CHARLES J. S. BETHUNE,
Editor.

TRINITY COLLEGE SCHOOL,
PORT HOPE.

OFFICERS FOR 1897-8.

President	Henry H. Lyman, M.A	Montreal.
Vice-President	Professor J. H. Panton, M.A , F G.S	Guelph.
Secretary	W. E. Saunders	London.
Treasurer	J. Balkwill	do
Directors:		
Division No. 1	W. H. Harrington, F.R.S.C	Ottawa.
" 2	J. D. Evans	Trenton.
" 3	Arthur Gibson	Toronto.
" 4	A. H. Kilman	Ridgeway.
" 5	R. W. Rennie	London.
Ex-Officio Directors (Ex-Presidents of the Society)	Prof. Wm. Saunders, L L.D., F.R.S.C., F.L.S	Ottawa.
	Rev. C. J. S. Bethune, M.A., D.C.L., F.R.S.C.	Port Hope.
	James Fletcher, L.L.D., F.R.S.C., F.L.S	Ottawa.
	John Dearness, I.P.S	London.
Libarian and Curator	J. Alston Moffat	do
Auditors	J. H. Bowman	do
	Wm. Lochhead	do
Editor of the "Canadian Entomologist"	Rev. Dr. Bethune	Port Hope.
Editing Committee	Dr. James Fletcher	Ottawa.
	Rev. T. W. Fyles, F.L S	South Quebec.
	Henry H. Lyman	Montreal.
	W H. Harrington	Ottawa.
	James White	Snelgrove.
Delegate to Royal Society	J. D. Evans	Trenton.
Delegates to the Western Fair.	John Dearness	London.
	W. E. Saunders	do
Committee on Field Days	Doctors Woolverton and Hotson, Messrs. Spence, Balkwill, Rennie, Elliott, Bowman, Anderson, Saunders and Law	London.
Library and Rooms Committee.	Messrs. Moffat, Bethune, Dearness, Saunders and Balkwill.	

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, 1897.

The thirty-fifth annual meeting of the Entomological Society of Ontario was held in its new room in the Young Men's Christian Association Building, Wellington Street, London, on Tuesday and Wednesday, October 12th and 13th, 1897, the President, Mr. J. W. Dearness, of London, occupying the Chair.

The meeting was called to order at 2 30 p.m., on Tuesday, when the following members were present: Dr. James Fletcher and Mr. W. H. Harrington, Ottawa; Mr. H. H. Lyman, Montreal; Rev, T. W. Fyles, Quebec; Mr. J. D. Evans, Trenton; Rev. C. J. S Bethune, Port Hope; Mr. T. Hart, Woodstock; Messrs. W. E. Saunders (Secretary), J. A. Balkwill, (Treasurer), J. A. Moffat (Curator), J. H. Bowman, C. D. Anderson, and J. Law, London.

Letters of apology were read from Prof. Panton, of Guelph, who had been seriously ill for some weeks, and Mr. Arthur Gibson, of Toronto, regretting their inability to attend. The Chairman also reported that Mr. A. H. Kilman, of Ridgeway, one of the Directors of the Society, was ill in a hospital at Buffalo, N.Y.

The first paper was read by the Rev. T. W. Fyles on "An Arctian Larva—What is it?" and was illustrated by specimens of the moth from which the eggs were obtained and of some varieties of *Hyphantria cunea*. Dr. Fletcher, in commenting on the paper, said that Dr. Riley, in the Report of the Entomological Commission on Forest Insects, page 246, had figured ten varieties of this moth ranging from the common pure white, immaculate form to one profusely dotted with black and brown, and expressed his belief, founded upon the frequent breeding of specimens, that these are all varieties of one species, which should be known by Drury's name of *H. cunea* rather than *H. textor*, Harris.

Mr. Lyman said that this was an opposite case to that of *Euchaetes collaris* and *eale*, which were supposed for a long time to be the same, but were found by breeding to be different species

Mr. Lyman read a paper by Mr. Winn and himself entitled "Notes on Grapta Interrogationis," which will be published in the December number of "The Canadian Entomologist" This butterfly was very abundant about Montreal and other parts of the Province of Quebec during the season of 1896. Advantage was taken of this abundance by the authors of the paper to rear the insect from egg to imago in considerable numbers and in this way to settle some doubtful points in its life history. They described the various incidents that related to the rearing, egg-laying, duration of moults and of larval and pupal stages, emergence of the imago, etc. The larvæ were fed on elm and hop, in confinement and out-of-doors, and many in their natural condition were found to be severely parasitized Out of one batch of 101 eggs laid by a single female, Mr. Lyman made a microscopical examination of fifty-two, and found that of these thirty-one had nine ribs and twenty-one had ten. This year (1897) only one specimen of the butterfly was seen by Mr. Winn.

Mr. Fyles spoke of the former rarity of this butterfly in the Province of Quebec, and how for a few years it became fairly common, culminating in the remarkable abundance during 1896

Dr. Fletcher drew attention to the fact observed by Mr. Lyman that the eggs laid by a single female had a variation in the number of ribs, though Mr. Scudder had supposed that each female would lay eggs with the same number of ribs, the number possibly varying with different individuals. The ordinary food plant is the elm, but it feeds also on nettle as well as hop. He found that the butterflies of the Vanessa group were very variable as regards the number of individuals from year to year. Sometimes *V. Antiopa* was so abundant on the young elms at the Ottawa Experimental Farm that the larvæ had to be destroyed in order to save the trees.

Dr. Fletcher then brought up the subject of facilities for obtaining illustrations for "The Canadian Entomologist," and asked for information regarding cost, length of time required for execution, etc. Dr. Bethune in reply gave a full explanation of what was done regarding the many beautiful plates and excellent wood cuts that had appeared in the magazine during the last year or two, and pointed out the difference in the mode of preparing photo gravures and process reproductions and their relative cost.

The meeting then adjourned till the evening, and the Council at once held a session for the transaction of business. The President remarked upon the removal of the Society's property since the last annual meeting to their new quarters, and the work done by the Curator in the moving. The local committee thought that some substantial expression of the Society's appreciation of the work that Mr. Moffat had performed should be made.

Mr. Balkwill said that there had been a great deal of extra labour involved in the moving, packing and unpacking of the cabinets and specimens, the taking down and rearranging of the library, etc., and that all had been done with so much care that on books or specimens were damaged in any way.

Mr. Fyles congratulated the members on their happy removal from the old building to the present cheerful room, and the escape from the beating of drums and other noises from the Salvation Army barracks below that often proved a serious annoyance. He thought that the thanks of the Council were fully due to the Curator, and that some substantial recognition of his careful work and extra labour should be made.

Dr. Fletcher concurred in the congratulations on the removal into so nice a room and into so fine a building, and he considered that the Society was under great obligation to Mr Moffat for his unfailing kindness for many years to all the members of the Society in naming specimens and doing other work which could not be fairly said to be included in his duties.

Mr. Balkwill, in presenting the following resolution, said that the sum was not as large as he would like to see given, but he thought that it was all that the limited funds of the Society could afford. He then moved, seconded by Mr. W. E Saunders. That the Council desire to place on record their appreciation of the services of the Curator, Mr. J. Alston Moffat, during the removal of the books and specimens from the former to the present room, and it is resolved that the sum of twenty-five dollars be given to Mr. Moffat in recognition of his labour on this occasion—*Carried.*

The question of the heating of the room was next discussed, and it was then stated that it was inadequate in the autumn and early winter and again in the spring. The President was authorized to bring the matter before the officials of the Y. M. C. Association in order that the difficulty might be remedied, and also to sign and execute the lease.

Dr. Bethune drew attention to a suggestion of the President that each Director of the Society should be expected to make at the annual meeting a short report on the insects in his district which had been of special note during the season; he thought it an admirable idea and one that if carried out would add much to the value and interest of the annual report. The suggestion was highly approved of by those present, and it was decided that it should be the duty of the Directors in future to make such reports.

Mr. Fyles, at the request of Dr. Fletcher, gave an interesting account of the formation of the Quebec Branch of the Society, which was already so successful and numbered about five and twenty members.

In the evening the Society held a public meeting in its new room on Wellington street, at which there was a largely increased attendance of members and friends. In addition to those who were present during the day may be mentioned Messrs. H. P. Bock, B. Green, T. Green, R. W. Rennie, W. Scarrow, W. Percival, J. B. Spencer, W. Lochhead and Drs Woolverton and Stevenson, London. The chair was taken by the President, Mr. Dearness, at 8 o'clock, and the meeting was opened by the reading of the report of the Council for the past year by the secretary, Mr. W. E. Saunders, which was on motion adopted.

REPORT OF COUNCIL.

The Council of the Entomological Society of Ontario have much pleasure in presenting the following report of their proceedings during the past year:

They have great gratification in stating that the work and influence of the Society have been much extended, and its membership increased by the formation of Branches in Toronto and Quebec. "The Toronto Entomological Society" was formed in February, 1896, with Mr. E. V. Rippon as president, and Mr. Arthur Gibson as secretary; regular fortnightly meetings were held and much enthusiasm was displayed by the members. Towards the end of the year the desirability of affiliating with our Society was brought before the members, and after full deliberation it was decided to join us on the first of January, 1897, and to become a Branch of this incorporated Society in accordance with the terms of our constitution. A few months later another Branch of the Society was formed at Quebec through the exertions of our colleague, the Rev. T. W. Fyles, and twenty more names were added to our roll of membership. The old established Branch at Montreal is as vigorous as ever and continues to accomplish much good work. The Society has now four centres for holding regular meetings and promoting the welfare and extending the usefulness of the students of entomology in Canada It is to be hoped that before long similar work may be carried on in the Maritime Provinces where little interest has yet been shown in this department of natural science, but where a great deal of important work could undoubtedly be done.

The twenty seventh annual report on Economic and General Entomology was presented to the Minister of Agriculture for Ontario in December last, and was printed and distributed in the beginning of May. It contained one hundred and twenty-seven pages and was illustrated with one hundred and three wood cuts and six full page plates. With the exception of the first report (1870), it was the largest volume yet issued by the Society and contained more illustrations than any previous one. In addition to an account of the proceedings at the last annual meeting, the report contains the annual address of the president, Mr. John Dearness and the following interesting and important papers: "Some insectivorous Mammals," by Mr. Robert Elliott; "Notes on the Season of 1896," by Messrs. Fyles, Fletcher, Bethune, Moffat and Gibson; "Entomology for Rural Schools," and "Two Insect pests of 1896," (the Army-worm and Tussock moth) by Prof. Panton; "The importance of Entomological Studies to an Agricultural and Fruit-Growing Community," and "Lepidopterous Pests of the Meadow and the Lawn," by the Rev. T. W. Fyles; "Some beetles occurring upon Beech," by Mr. W. H. Harrington; "The San Jose Scale" and "Warning Colours, protective mimicry and protective coloration," by Prof. F. M. Webster.

The Canadian Entomologist, the monthly magazine published by the Society, completed its twenty-eighth volume in December last. Ten numbers of the twenty-ninth volume have now been issued; they contain 248 pages and are illustrated with eight full page plates, several of them of great beauty, and a number of original wood cuts Among the many valuable papers published may be mentioned the continuation of the series of illustrated articles on the Coleoptera of Canada, by Prof. H. F. Wickham, which are most useful to students of this order, and are specially designed to be of assistance to beginners of the study of our beetles. It is with profound regret that the Council have learnt from Prof. Wickham that he is obliged to abandon the study of systematic entomology on account of trouble with his eyes, and they desire to express their deep sympathy with him in this affliction which so seriously interferes with his valuable and important work.

A number of interesting specimens of moths new to the Canadian lists have been added to the Society's collection by the kindness of Mr. J. Bice who has been a diligent collector at the electric lights in the city of London.

In the latter part of November, 1896, the Society removed its head quarters from the rooms it had occupied for over sixteen years in Victoria Hall on Clarence street to more accessible, commodious and better lighted premises in the Young Men's Christian Association fine new building on Wellington street. The cases of books and insects were

Dr. Fletcher then brought up the subject of facilities for obtaining illustrations for "The Canadian Entomologist," and asked for information regarding cost, length of time required for execution, etc. Dr. Bethune in reply gave a full explanation of what was done regarding the many beautiful plates and excellent wood cuts that had appeared in the magazine during the last year or two, and pointed out the difference in the mode of preparing photo gravures and process reproductions and their relative cost.

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Dr. Bethune drew attention to a suggestion of the President that each Director of the Society should be expected to make at the annual meeting a short report on the insects in his district which had been of special note during the season ; he thought it an admirable idea and one that if carried out would add much to the value and interest of the annual report. The suggestion was highly approved of by those present, and it was decided that it should be the duty of the Directors in future to make such reports.

Mr. Fyles, at the request of Dr. Fletcher, gave an interesting account of the formation of the Quebec Branch of the Society, which was already so successful and numbered about five and twenty members.

In the evening the Society held a public meeting in its new room on Wellington street, at which there was a largely increased attendance of members and friends. In addition to those who were present during the day may be mentioned Messrs. H. P. Bock, B. Green, T. Green, R. W. Rennie, W. Scarrow, W. Percival, J. B. Spencer, W. Lochhead and Drs Woolverton and Stevenson, London. The chair was taken by the President, Mr. Dearness, at 8 o'clock, and the meeting was opened by the reading of the report of the Council for the past year by the secretary, Mr. W. E. Saunders, which was on motion adopted.

REPORT OF COUNCIL.

The Council of the Entomological Society of Ontario have much pleasure in presenting the following report of their proceedings during the past year:

They have great gratification in stating that the work and influence of the Society have been much extended, and its membership increased by the formation of Branches in Toronto and Quebec. "The Toronto Entomological Society" was formed in February, 1896, with Mr. E. V. Rippon as president, and Mr. Arthur Gibson as secretary; regular fortnightly meetings were held and much enthusiasm was displayed by the members. Towards the end of the year the desirability of affiliating with our Society was brought before the members, and after full deliberation it was decided to join us on the first of January, 1897, and to become a Branch of this incorporated Society in accordance with the terms of our constitution. A few months later another Branch of the Society was formed at Quebec through the exertions of our colleague, the Rev. T. W. Fyles, and twenty more names were added to our roll of membership. The old established Branch at Montreal is as vigorous as ever and continues to accomplish much good work. The Society has now four centres for holding regular meetings and promoting the welfare and extending the usefulness of the students of entomology in Canada It is to be hoped that before long similar work may be carried on in the Maritime Provinces where little interest has yet been shown in this department of natural science, but where a great deal of important work could undoubtedly be done.

The twenty seventh annual report on Economic and General Entomology was presented to the Minister of Agriculture for Ontario in December last, and was printed and distributed in the beginning of May. It contained one hundred and twenty-seven pages and was illustrated with one hundred and three wood cuts and six full page plates. With the exception of the first report (1870), it was the largest volume yet issued by the Society and contained more illustrations than any previous one. In addition to an account of the proceedings at the last annual meeting, the report contains the annual address of the president, Mr. John Dearness and the following interesting and important papers: "Some insectivorous Mammals," by Mr. Robert Elliott; "Notes on the Season of 1896," by Messrs. Fyles, Fletcher, Bethune, Moffat and Gibson; "Entomology for Rural Schools," and "Two Insect pests of 1896," (the Army-worm and Tussock moth) by Prof. Panton; "The importance of Entomological Studies to an Agricultural and Fruit-Growing Community," and "Lepidopterous Pests of the Meadow and the Lawn," by the Rev. T. W. Fyles; "Some beetles occurring upon Beech," by Mr. W. H. Harrington; "The San Jose Scale" and "Warning Colours, protective mimicry and protective coloration," by Prof. F. M. Webster.

The Canadian Entomologist, the monthly magazine published by the Society, completed its twenty-eighth volume in December last. Ten numbers of the twenty-ninth volume have now been issued; they contain 248 pages and are illustrated with eight full page plates, several of them of great beauty, and a number of original wood cuts Among the many valuable papers published may be mentioned the continuation of the series of illustrated articles on the Coleoptera of Canada, by Prof. H. F. Wickham, which are most useful to students of this order, and are specially designed to be of assistance to beginners of the study of our beetles. It is with profound regret that the Council have learnt from Prof. Wickham that he is obliged to abandon the study of systematic entomology on account of trouble with his eyes, and they desire to express their deep sympathy with him in this affliction which so seriously interferes with his valuable and important work.

A number of interesting specimens of moths new to the Canadian lists have been added to the Society's collection by the kindness of Mr. J. Bice who has been a diligent collector at the electric lights in the city of London.

In the latter part of November, 1896, the Society removed its head quarters from the rooms it had occupied for over sixteen years in Victoria Hall on Clarence street to more accessible, commodious and better lighted premises in the Young Men's Christian Association fine new building on Wellington street. The cases of books and insects were safely and conveniently installed without loss or injury under the careful management of the curator, Mr. J. Alston Moffat In the new rooms the Council believe that the valuable property of the Society will be safer from fire and more easily reached by the members and the public. (See Plate 2 which shows a part of the Library.)

The Librarian's report will show that a large number of volumes of scientific Societies' publications and pamphlets have been bound and placed for consultation on the shelves. The "Canadian Entomologist" is exchanged for the proceedings of various scientific and learned societies in all parts of the world. The number of such exchanges at present on the list is 74.

The Council desires to express its entire satisfaction with the efficient manner in which the curator, Mr. J. Alston Moffat continues to discharge his duties.

The Treasurer's report shows that the finances of the Society are in a very satisfactory condition. While the expenses have been necessarily increased, owing to the change of rooms and the cost of removal, the balance on hand will no doubt be sufficient to provide for the expenditure that will be required during the remainder of the year.

The reports of the Secretaries of the several scientific sections of the Society, printed elsewhere, show that they continue to hold regular meetings and to accomplish much useful work.

The Society was represented at the meeting of the Royal Society of Canada, held at Halifax, Nova Scotia, in the month of June last, by Mr. J. D. Evans, of Trenton, whose report is published herewith. At the meeting of the British Association for the Advancement of Science, held in Toronto in August, the Society was represented by the president, Mr. J. Dearness, and the editor, Dr. Bethune, and was attended by several other of the members.

All of which is respectfully submitted.

LONDON, October 12, 1897.

JOHN DEARNESS,
President.

REPORT OF THE MONTREAL BRANCH.

The 207th regular and 24th annual meeting of the Montreal Branch of the Entomological Society of Ontario was held in the rooms of the Natural History Society of Montreal on 25th May.

The following members were present: Messrs. H. H. Lyman, President; A. F. Winn, Vice-President; G. C. Dunlop, T. Dwight Brainard, A. Griffin, J. B. Williams, E. A. Norris, H. T. Pye, L. Reford, C. Stevenson, G. A. Moore and L. Gibb, Sec.-Treas.

The chair was taken by the President and the minutes of the previous regular meeting were read and confirmed, and the minutes of the last annual meeting were also read.

The President then submitted the following report of the Council for the past year:

REPORT OF COUNCIL.

In presenting their twenty-fourth annual report the Council have much pleasure in referring to the continued prosperity of the Branch.

Since our last annual meeting two new members have been added to our roll, but two others have resigned and we have also to deplore the loss by death of Mr. George Kearley, whose genial disposition and interest in the Branch and its work had won our high esteem.

During the year eight meetings have been held, at one of which we had the pleasure of the attendance of the Rev. Dr. Bethune, whom our members had thus the pleasure of meeting for the first time, and the following papers and communications were read:

Annual address by the President, H. H. Lyman.

Nasturtium as a food plant of Pieris Rapæ A. F. Winn.

Descriptions of two remarkable aberrations of Colias Philodice. J. D. Brainerd.

Address on the past season. Rev. Dr. Bethune.

The Crambidæ of the Province of Quebec. Rev. T. W. Fyles.

Notes on Grapta Interrogationis. A. F. Winn.

Notes on Grapta Interrogationis. H. H. Lyman.

A novel breeding cage. E. A. Norris.

Butterfly books. H. H. Lyman.

Description of the larva and pupa of Aulax Nabali. Rev. T. W. Fyles.

Notes on the past season of 1896 at Edgarstown, Mass. T. D. Brainerd.

Notes on Colias Cæsonia. Sent by T. E. Bean.

Notes on the occurrance of Thyatira Rectangulata in Canada. A. F. Winn.

Notes on the season of 1896. H. H. Lyman.

During the season several of our members again co-operated with the Natural History ciety in continuing the course of short lectures to young people, on Saturday afternoons, ith, it is believed, encouraging results.

Greetings have been exchanged with the newly formed Toronto Branch and we joice to learn that another branch has been formed in this Province, in the ancient City f Quebec, where a branch formerly flourished.

The Treasurer's report shows that the finances of the Branch are in a satisfactory ndition.

Respectfully submitted on behalf of the Council.

H. H. Lyman,
President.

The Treasurer then submitted his report, which showed an accumulated balance on and of $35.46.

Upon the motion of Mr. G. C. Dunlop, seconded by Mr. C. Stephenson, the reports the Council and Treasurer were received and adopted.

The President then read his annual address, giving a resume of the past year's work nd pointing out a few lines for future guidance.

Some discussion then took place upon the suggestion to obtain a cabinet for a general llection for the Branch, the matter being finally left in the hands of the incoming council.

The following officers were then elected for the ensuing year:

President—HENRY H. LYMAN.

Vice-President—A. F. WINN.

Secretary-Treasurer—LACHLAN GIBB.

Council—G. C. DUNLOP and T. DWIGHT BRAINERD.

The meeting then adjourned.

LACHLAN GIBB.
Secretary-Treasurer.

REPORT OF THE QUEBEC BRANCH.

The Quebec Branch of the Entomological Society of Ontario came into existance at the close of a course of lectures on natural science given in Morrin College during the winter of 1896 97.

It was thought desirable that an interest in entomological and botanical pursuits should be continued during the summer vacation and to promote this interest the formation of an Entomological Association was determined upon.

At a meeting held in Morrin College on Wednesday, April 7th, and presided over by Reverend Principal Macrae, M.A., D.D., a constitution was adopted, officers were chosen, and a resolution asking for recognation by the Ontario Society was agreed upon.

The following is the list of officers:

President—REV. PROFESSOR FYLES:

Vice-President—Miss MACDONALD, Principal of the Quebec Girls' High School.

Secretary-Treasurer—LIEUT-COL. CRAWFORD LINDSAY.

Council—MESSRS. J. GEGGIE, RICHARD TURNER and J. EVELEIGH TREFFRY; The Misses BICKELL and B. WINFIELD.

On the 10th of May, the members met at the house of the President to examine his extensive collections. On this occasion the equipments necessary for a working entomologist were examined, and the methods of capturing, preserving and mounting insects were noted.

A field day was held at the "Gomin" on June 12th, when a number of rare specimens were taken. The presence and help of Messrs. Winn and Brainerd, of the Montreal Branch, added greately to the day's enjoyment

After the summer holidays, the members again met to compare and identify specimens. The President gave an address on the condition of the insect world in the winter months; and Professor Walters one on "Entomological Experiences at Bourg Louis." *Colias interior*, *Terias lisa*, *Phyciodes Harrisii* and other rare insects were taken by Mr. Walters at that place.

By kind permission of the authorities of Morrin College, the members of the Branch enjoy the privilege of holding their regular meetings in the College Buildings and of attending the College lectures on natural history.

W. A. CRAWFORD LINDSAY,
Secretary-Treasurer

REPORT OF THE TORONTO BRANCH.

The first annual general meeting of the Toronto branch was held in the Society's room, 451 Parliament street, on Friday evening, the 2nd April, 1897.

The following members were present: E. V. Rippon, President; Arthur Gibson, Secretary Treasurer; T. G. Priddey, Librarian Curator; C. T. Hills, R. J. Crew, C. H. Tyers, J. H. McDunnough, H S. Austen, Arthur Cherry and H. D. Chipman.

The Secretary read the following report of the Council, which was duly adopted:

REPORT OF COUNCIL.

The Council of the Toronto branch of the Entomological Society of Ontario take pleasure in presenting the following report of the proceedings of the Society during the past year.

While the membership of the Society has not increased to any great extent, yet the Council feel that the first year of the Society's existence has been a success. Since organization eight new members have been added to the roll. Of these eight, five have severed their connection with the Society, while the other three are still interested in its welfare. The membership now numbers twelve, and the council have every reason to hope that these figures will be increased during the coming year.

A most important event in connection with the Society was the affiliation of the Toronto Entomological Society with the Entomological Society of Ontario. This affiliation took place on the 1st January last, since which date the Society has been known as the Toronto Branch of the Entomological Society of Ontario.

During the past year twenty-four ordinary meetings have been held, and the following list of papers, contributed by the members, added much to their success :

March 6th, 1896.—The Classification of Insects, by Mr. T. G. Priddey.

March 20th, 1896.—A Few Notes on Coleoptera, by Mr. R J. Crew.

April 2nd, 1896.—The Sphingidae, or Hawk Moths, by Mr. Arthur Gibson.

April 17th, 1896.—Notes on the ova of Lepidoptera, by Mr. C. T. Hills.

May 1st, 1896.—A new species of Diptera, belonging to the Genus Diopsis, by Mr. E. V. Rippon.

May 15th, 1896.—Mysteries of Insect Life. by Mr. T. G. Priddey.

September 18th, 1896.—Notes on Toronto Sphingidae, by Mr. J. H. McDunnough.

October 2nd, 1896.—Notes on Collecting Coleoptera, by Mr. R. J. Crew.

December 4th, 1896.—Injurious Insects, by Mr. C. H. Tyers.

January 8th, 1897.—Sense of Sight in Insects, by Mr. S. R. Carter.

February 5th, 1897.—The Uses of Insects, by Mr. Arthur Gibson.

March 5th, 1897.—Obnoxious Insects, by Mr. T. G. Priddey.

The number of volumes in the library at the present date is forty-six, besides some fifty-two pamphlets, Government bulletins, etc., all relating to Entomology, and all of which have been kindly donated to the Society during the past year.

Considerable work has been done on the Society's collection of insects, especially during the last few months, and through the kindness of the members in presenting specimens, a fair number of insects are now in the Society's possesssion.

The Treasurer's report shows that the finances are in a satisfactory condition. Among the expenditure will be noticed that a considerable sum has been spent in the purchase of chairs, cases, etc., and also for rent of room.

Respectfully submitted on behalf of the council.

E. V. Rippon,
President.

The reports of the Treasurer and Curator-Librarian were submitted and on motion duly adopted as read.

The election of officers for the ensuing year resulted as follaws :

President.—E. V. Rippon.

Vice-President.—R. J. Crew.

Secretary-Treasurer.—Arthur Gibson.

Curator-Librarian.—T. G. Priddey.

Council.—C. T. Hills and C. H. Tyers.

The President then addressed the meeting, and in the course of his remarks congratulated the members on the work done during the year, and felt certain that the first year of the Society's existence had been a success. During the coming season he hoped that each member would take a special interest in some particular species, working out the life history of at least one insect, and also that considerable time would be spent in the study of those insects which are beneficial or injurious to mankind. In the United States particulary economic entomology is making great strides, and Mr. Rippon advised the members to give particular attention during the coming season to those insects which are known to be injurious. Concluding, Mr. Rippon thanked the members for the honor conferred upon him in re-electing him to the position of President for the ensuing year.

The meeting then adjourned.

Arthur Gibson,
Secretary.

REPORT OF THE BOTANICAL SECTION.

The Botanical Section organized in April.

A paper, illustrated with a fine series of examples, on Narcissus was presented by Mr. J. B. Bond.

One evening was devoted to Prof. Bailey's work on Plant Breeding, led by Mr. Dearness.

Another interesting paper by Mr. Pond on Iris afforded material for an evening's profitable discussion.

The other meetings were more or less informal and were occupied by examining and discussing specimens brought by the members.

Additions to the local flora were Draba Caroliniana, Anthemis arvensis, and Specularia perfoliata. Messrs. Bowman, Dearness, Elliott and Balkwill were the chief collectors.

J. B. Bond, Chairman.
Elliott Richmond, Secretary.

REPORT OF THE GEOLOGICAL SECTION.

The Section in Geology beg to submit their annual report as follows:—

The meetings have been held weekly throughout the year with the exception of six weeks in midsummer.

During this interval several of our members made holiday excursions to various parts of our country, for the collection of material, and gaining useful information on subjects pertaining to our branch of science.

We have extended our trips to a greater distance from home than usual.

Mr. George Kirke spent several weeks in the northwest mineral regions in the vicinity of Rossland.

Mr. Brown spent five or six months prospecting on the north shore of Lake Superior and in the Wabigoon district.

Mr. A. Blackburn has been opening mines in the Lake of the Woods district.

Dr. Woolverton, chairman of the Section, has lately returned from collecting minerals from the north Hastings gold fields.

This shows great activity on the part of our members, and a determination to become better acquainted with the mineral resources of our country.

Our removal to the present room provided by the parent society, has not given us, we anticipated, any more room for the display of specimens pertaining to our particular section. In other respects it is all that could be desired.

Many specimens of ores have been received, and placed upon the table, from various mining locations throughout the country, and we are pleased to learn that a large collection of minerals and ores from British Columbia has lately been sent, as a gift to our Public Library collection, to which our memb rs will have free access.

The subjects studied during the year were various.

We reported to the local papers the find of coal or anthroxolite in the vicinity of Sudbury. Its value as a fuel has not yet been definitely settled by geologists.

We received the borings of various wells put down for oil in the vicinity of London, viz. :—Delaware, Parkhill and Mount Brydges, only a slight trace of oil being met with so far, showing that they are not within the true oil belt.

The Section has been materially assisted by donations of some of the products of the factories at Niagara Falls—resulting from the great electrical power now generated at that point.

Dr Hough, a resident of that place, sent a small box containing carbide of calcium from which is made acetylene gas, which is likely to prove of some importance in the near future.

We also obtained from the proprietor of the carborundum works, fine specimens of this material, which, in hardness, exceeds anything in nature or art except the diamond. This may be called the first step in the manufacturing of diamonds.

By vote of the Section the chairman was asked to attend the meeting of the British Association for the Advancement of Science at Toronto and report thereon, which was satisfactorily carried out.

Papers were read by the following members of the Section :

I. Dr. Wilson.
II. Mr. Geo. Kirke.
III. Mr. Goodburn.
IV. Mr. John Law.
V. Mr. D. G. Buchanan.

Steps are being taken to establish a public collection as a necleus for a museum in our Public Library.

Our members are ready to assist in carrying out the project to a successful issue as this would assist them in their work and also widen the sphere of influence in the Geological Section.

Submitted on behalf of the Section.

S. Woolverton, Chairman.
John Law, Secretary.

A large and very handsome specimen of carborundum was exhibited to the meeting by Dr. Woolverton, who procured it from the works at Niagara Falls.

REPORT OF THE MICROSCOPICAL SECTION.

During the past season, meetings were held every two weeks after the opening meeting, until the close of the term in March. The average attendance was eight members. In addition to these meetings the Entomological Society kept open house on the first of January, 1897, this being the formal opening of the Y.M.C.A. building, in which the Society's new rooms are located, and on this occasion one of the principal attractions was the exhibit of microscopic objects by the members of this Section, and much interest was shown by the numerous visitors in the display. Eight or nine members took part, and the rooms were kept open all day as well as in the evening.

Among the papers read at the meetings of this year were the following: A Study of Lichens, by Prof. John Dearness; a subsequent evening being devoted to the practical handling, examination, and the mounting of these interesting plants, under the direction of the same gentleman.

The Growth of Ferns, by Wm. Lockhead, M.A., illustrated by blackboard drawings and figures drawn by the speaker from microscopic mounts.

Observations on microscopic and other forms noted during a recent trip across the Continent, by W. E. Saunders; illustrated by specimens of interest in various branches of natural life.

Microscopic Manipulation, by R. W. Rennie, illustrated by beautiful pieces of apparatus made by the speaker. The attendance and interest in the meetings were good, and on the whole, the Section looks back on a fairly satisfactory year.

J. H. BOWMAN, Secretary.

REPORT FROM THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

Having been chosen as the Delegate to represent the Entomological Society of Ontario on this most interesting occasion, the commemoration of the landing of Cabot, it becomes my privilege to submit a report of its work and proceedings during the past year.

The membership of the Society I am pleased to report has been well maintained and in addition thereto it is very gratifying to be able to say that on or about the opening of the current year a branch of this Society was inaugurated in Toronto by the affiliation of the Local Society formed about a year before, thus starting out with quite a considerable membership and manifesting much enthusiasm under the new regime.

The additions to the library were quite important including, among others, a full set of the annals of the "Entomological Society of France." The additional volumes, numbering nineteen, thus bringing the total library register up to 1,418 volumes.

There was also a limited addition to the collection of insects.

The official organ of the Society, "The Canadian Entomologist," still maintains its high standing among its class of literature. During the year 1896 it completed its twenty-eighth volume of 319 pages. Of the forty-eight contributors thirty were from the United States, two from New Mexico, one from New Zealand, two from Europe, the remaining thirteen being Canadian. The contributors aggregated eighty-six articles, in some of which were described one hundred and eleven new species and four new genera.

Among the more important papers published during the year the following deserve particular mention.

The Coleoptera of Canada, by Prof. H. F. Wickham. These are a very useful series of illustrated articles for beginners as well as those more advanced. They were continued through five numbers and are a continuation of similar articles in two previous years.

The North American species of Gnathodus, by Mr. Carl F. Baker.

The American species of Isotoma, by Mr. Alex. D. MacGillivray.

Canadian Hymenoptera No. 7, by Mr. W. Hague Harrington, F.R.S.C.

A Contribution to the knowledge of North American Syrphidae, by Mr. W. D. Hunter.

Lepyrus, by John Hamilton, M.D.

The Cigar case bearer of the Apple (Coleophora Fletcherella,) by Dr. Jas. Fletcher.

New American parasitic of Cynipidae (Allotriinae), by Mr. Carl F. Baker.

The larger species of Argynnis and the mystery of their life history, by Mr. H. H. Lyman, M.A.

On two interesting new genera of scale insect parasites, by Mr. L. O. Howard.

Index to the Mantidae of North America North of Mexico, by Mr. Samuel H. Scudder.

A summary of the members of the Genus Chilosia, Meig, in North America with descriptions of new species, by Mr. W. D. Hunter.

Some notes on Insect enemies of trees, by Mr. A. D. Hopkins.

Some new Nematids, by C. L. Marlatt.

Notes on the preparatory stages of Erebia Epipsodea, Butler, by Mr. H. H. Lyman, M.A.

A number of book notices, current publications of Entomological literature, correspondence, obituary notices, etc., also appear. At this time it will not be inopportune to mention the serious loss to the Society, from death, of two of its very active members, Mr. John M. Denton of London, and Captain J. Gamble Geddes, of Toronto.

The thirty-fourth Annual Meeting of the Society was held in its rooms in London, on Wednesday and Thursday, the 21st and 22nd of October, 1896. A very full report of these proceedings is given in the Annual Report published by the Society (in addition to the Monthly Magazine) to the Department of Agriculture of the Province of Ontario.

This report consists or 127 pages replete with numerous illustrations. Two plates of these illustrations are worthy of particular mention as illustrating the study of economic entomology in the public schools, a work which should be heartily commended.

In addition to the report of the proceedings of the parent Society in which is embodied an extended and interesting Annual Address from the President, it contains also—

The reports of the Geological, Botanical, and Microscopical Sections of the Entomological Society.

The report of the Montreal branch with the annual address of its President.

And the report from the Entomological Society of Ontario to the Royal Society of Canada.

The following papers also appear in this annual report, viz.

Notes on the season of 1896, by Rev. T. W. Fyles, F.L.S.

Some insectivorcus Mammals, by Mr. Robert Elliott.

Entomology for Rural Schools, by Prof. J. Hoyes Panton. Especially to be commended for the introduction and propagation of knowledge of economic Entomology among the children of both sexes.

The importance of Entomological Studies to an Agricultural and Fruit-growing Community, by Rev. Thos. W. Fyles, F.L.S.

Two Insect Pests of 1896, by Prof. J. Hoyes Panton.

Notes on insects of the Year 1896, by Rev. C. J. S. Bethune.

Insect injuries to Ontario Crops in 1896, by Dr. Jas. Fletcher.

Some Beetles occuring upon Beech, by Mr. W. Hague Harrington, F.R.S.C.

Notes on the Season of 1896, by Mr. J. Alston Moffat.

Warning Colours, Protective Mimicry, and Protective Coloration, by Prof. F. M. Webster.

The San Jose Scale, by Prof. F. M. Webster. A very exhaustive and valuable treatise on the subject.

Lepidopterous Pests of the Meadow and the Lawn, by Rev. T. W. Fyles, F.L.S.

Rare Captures during the Season of 1896, by Mr. Arthur Gibson.

The Butterflies of the Eastern Provinces of Canada, by Rev. C. J. S. Bethune.

The Geological Section reported that regular meetings were held weekly during the year with a fair attendance. Several places of geological interest had been visited by members and collections made. Valuable papers had been read, also four or five lectures given.

A collection of minerals having been presented by the Dominion Government to the free library, which is accessible to our members, will be an incentive to more active work and increased membership.

The Botanical Section reported that the weekly meetings from the 1st May to the middle of July were well attended, several very pleasant outings had been held, and that the work of the year had been encouraging.

The Microscopical Section reported having had a year of continued success with fornightly meetings from October 11th to April 17th, when its meetings was discontinued in favor of the Botanical Section. The subjects studied were arranged under ten different classifications, each led by a different member.

Each of the Sections above enumerated, as well as the parent society look forward with adticipations of much greater usefulness and increase of membership upon occupying the new suite of rooms which have been secured and are now occupied.

The Montreal Branch presents its twenty-third annual report which showed a very marked increase in the membership. Eight meetings had been held during the course of the year at which ten excellent papers had been read, and the financial status was explained to be in a very healthy condition. The President's annual address was a very impressive one, urging upon the members to undertake and work up some special subjects among the very many open and now neglected, and enumerating a long list of such.

John D. Evans,
Delegate.

ANNUAL ADDRESS OF THE PRESIDENT.

By John Dearness, I.P.S., London.

Members of the Entomological Society of Ontario :

Ladies and Gentlemen,—It is my pleasant duty this evening to welcome you to the thirty-fifth annual meeting of the Society.

Since our last annual gathering our quarters have been removed from a room in the highest flat in the old Victoria Hall to these commodious and well lighted apartments in the beautiful new Y.M.C.A. Building. The removal of the cases, library, instruments, etc., a difficult matter, was well directed by the librarian, assisted by Mr. Balkwill. It was effected without accident or injury to the glazed cases or specimens. The librarian merits our commendation and thanks for the pleasing and convenient arrangement of the library, specimens and furniture of the society in these rooms.

The year's work of the parent Society will be disclosed as the meeting progresses. Reports of branch societies and of the sections into which the members break up for the practical study of allied sciences will be presented by the respective officers This year we shall have the pleasure for the first time of having reports from two new branches formed respectively in Quebec City and Toronto.

Last year we mourned the enroachment made by death in the ranks of our membership At this meeting we are grateful that no name has thus to be taken off our roll, although our sympathies are called forth towards two of our directors who are unable to take part in the proceedings by reason of serious illness, viz., Mr. A. H. Kilman, director for the fourth division and Professor Panton We trust that God will bless the means employed to their speedy and complete recovery. Professor Panton's work last year was so helpful and acceptable that we miss him the more at this meeting.

THE INSECTS OF THE YEAR.

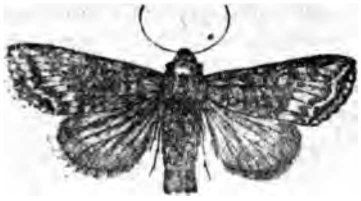

Fig. 1. Amputating brocade moth (*Hadena Arctica.*)

In 1895 a cut-worm moth (*Hadena Arctica*, Fig 1) in prodigious numbers made housekeepers miserable in the evenings,—in the following spring the larvæ of the same insect did great injury to grain crops sown on ground which had been freshly broken out of sod. One might expect when the time of the pupation of these larvæ had expired to witness a reappearance of the moth in increased numbers. Such expectation was happily entirely disappointed. Every suitable acre of pasture ground or meadow was doubtless as thickly stocked with the larvæ as those acres of spring grain referred to, many of which had to be re-sown. No parasite was reported on them. What became of them?

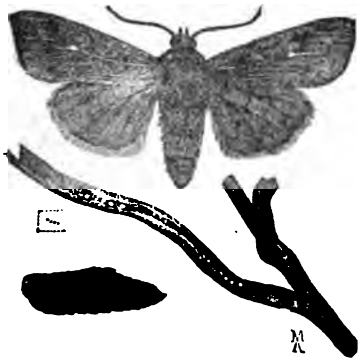

Fig. 2. Eggs, pupa and moth of the Army Worm *Leucania unipuncta.*)

Fig. 3. Army Worm.

In 1896 the army-worm (Figs. 2 and 3) devastated grain fields in many townships of Ontario, as witness the dark patches of infested country shown in the map of the Province published on page 45 of our last report. To illustrate how numerous they were in one school section in my own division: a lady told me that coming along at the time when the army was migrating from a grain field on the east side of the road in search of forage farther west they were so thick on the road that the faster travellers were crawling over the others instead of seeking a way round, if, indeed one could be found, and that not knowing but that the procession might be of indefinite duration she was constrained to lift her skirts and pick her steps on tip toe, even then very unwillingly stopping forever at every step the progress of some of the hungry marchers. The Province throughout its length and breadth was thus patched over with incalculable numbers of the army worm. True, their predatory enemies, during the short season their larvæ were fair prey, waxed fat and multiplied on them. The red-tailed Tachina, or possibly the yellow-tailed one, Fig. 4, adorned many a neck with one or two pretty eggs, but notwithstanding the great losses from these and other causes the one-spotted Leucania was the most common moth to be seen in the fall even in townships where not a larva had been reported Why was not the whole country overrun with the insect this year? The causes and conditions of the appearance and the still more curious disappearance of such insects as the amputating brocade (cut worm) moth and army worm challenge and invite investigation.

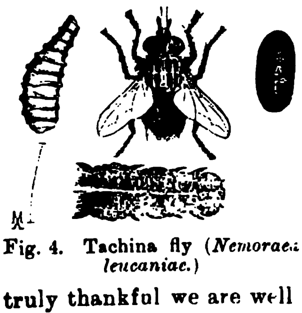

Fig. 4. Tachina fly (*Nemoraea leucaniae.*)

If the army worm had its "innings" last year, this year the San José Scale has had the lion's share of attention. It is to be earnestly hoped that we are more frightened than hurt, but I am truly thankful we are well frightened. So far as I know, Dr. Fletcher and Prof. Panton, the officers of the Ottawa and Guelph experiment stations, deserve the chief credit for sounding the alarm One benefit from the scare is that it has led many people to discover what a scale-insect is and to learn that for years their fruit trees have been injured by the native or naturalized species of this class of insect. If the alarm perpetuates, as it appears to have started, a crusade against scale insects of all kinds much good will result. I have been sent or shown several things and asked whether they were the dreaded scale. They were mostly the Oyster shell Bark-louse, *Mytilaspis pomorum* (Fig. 5) One or two I took to be the Scurfy Bark-louse (Fig. 6), others included the woolly aphis, insect eggs, and a species of lichen. Doubtless the experiment station officers could give a long list of similar inquiries Attention being diverted to those minute insects the presence of the San José one will be the more promptly detected. The destructiveness of this scale and the expense and difficulty of killing it except by methods that endanger its host, will, if a few more instances of its introduction from nurseries occur, lead to legislation. I have met some people who had got the idea that there is a quarantine already established against nursery stock imported from abroad. Reports of the efforts to obtain such measures on the other side of the line have probably given rise to the impression. This meeting offers a fitting time and place to give an expression as to whether legislative action should be taken *

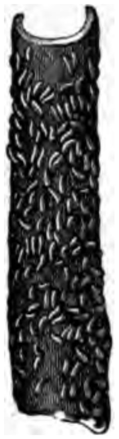

Fig. 5.
Oyster-shell
Bark-louse.

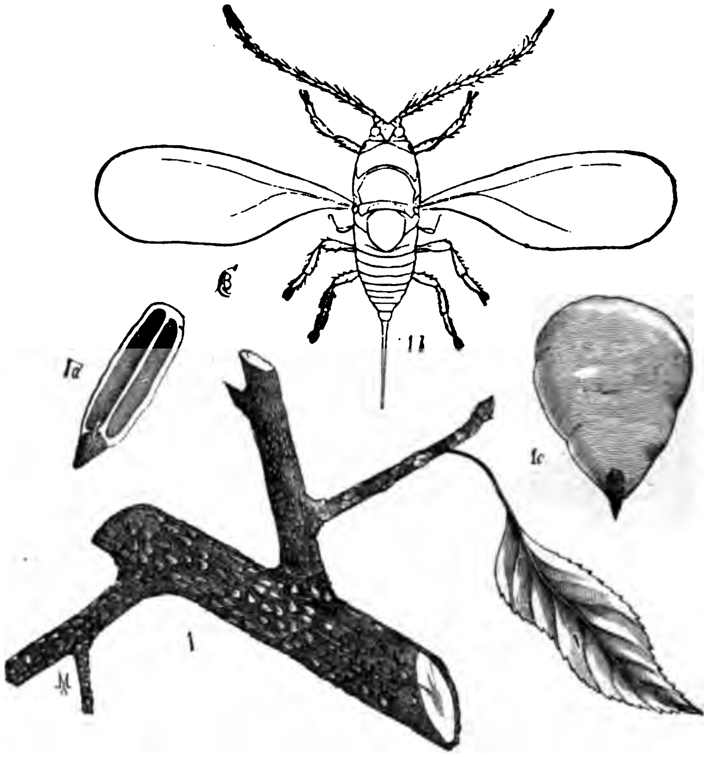

Fig. 6. The Scurfy Bark-louse (*Chionaspis furfurus.*)

The San José Scale, if it ever becomes established in this country, will not, like the moths above referred to, be marked by sudden disappearance, nor will it, like the codling-moth or pear *Psylla*, confine its ravages to a single species of tree, nor even to trees under cultivation Prof. Webster, of the Ohio Experiment Station, has published a list of twenty-two trees and shrubs upon which this scale has been found in his State. A list that includes plants with such dissimilar saps and cambiums as walnut, willow, elm, gooseberry, peach, grape, sumac and basswood may be extended to include almost every tree and shrub in the country. The State of Massachusetts has, within the past seven years, expended over $600,000 in its efforts to control and exterminate the gypsy moth, but no amount of money could effect the extermination of this destructive scale insect if it once got a foothold in a widely scattered number of our woodlands and orchards.

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*In a late discussion Dr. Fletcher placed reliance for the suppression of this insect more upon the education and individual efforts of farmers and of fruit-growers than on legislation. Government might assist—as it is doing now through establishing agencies—but it would be most dangerous for the people to lapse into indifference owing to the belief that they are protected by an Act of Parliament against invasion by this scale insect.

In respect to protection, we have much to hope from the vigilance and energetic action of econômic entomologists in the United States. In this connection much credit is due to Prof. Webster, of Wooster, for outspoken and manly denunciation of nursery companies he named who negligently contributed to the spread of this pest and of whose criminal negligence we have had a taste in Ontario. It was doubtless at his prompting that the Ohio Horticultural Society issued the call for the National Convention held in Washington last March to consider the suppression of insect pests and plant diseases by legislation. The proceedings of this convention served to direct attention to the dangers from imported insects that confront our fruit growers and to prepare the way for guaranteeing nursery stock and adopting other legislative preventives of the spread of pernicious insects and fungi.

ENTOMOLOGY IN SCHOOLS.

It must have pleased the friends of scientific education who read the last annual report to observe that the teaching of entomology in the public schools occupied so large a share of attention.

The Western Fair Board this year repeated its offer of prizes for the life histories of injurious insects exhibited by schools. The prizes were won by Mr. J. W. Atkinson's school, Avon P.O., and Miss Corsaut's, No. 15, London Township. The former exhibited the cabbage butterfly, *Pieris Rapæ,* in egg, larvae (Fig. 9*a*) blown and in alcohol, pupæ (Fig. 9*b*) and imagines of both sexes (Fig. 7 the male, Fig. 8 the female butterfly), pressed leaves showing the work of the larvæ, and a readable description of the insect and account of the observations made upon its life history.

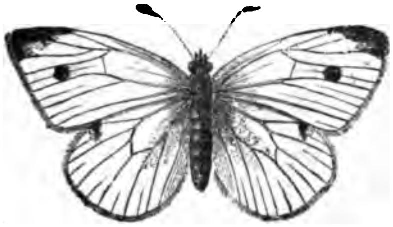
Fig. 7.—Pieris rapæ, male.

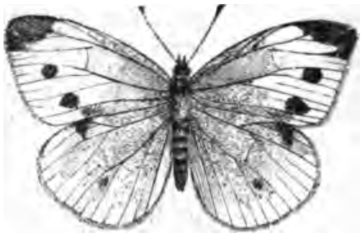
Fig. 8.—Pieris rapæ, female.

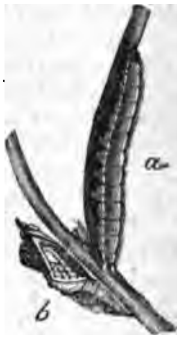

Fig. 9.—Pieris rapæ; *a*, caterpillar; *b*. chrysalis.

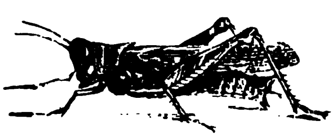
Fig. 10.—Red-legged grasshopper.

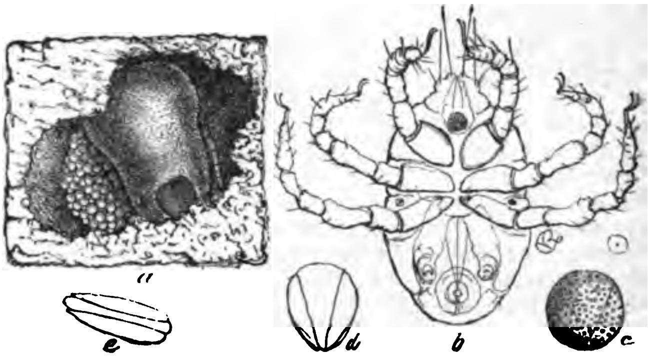

Fig. 11.—Trombidium Locustarum.—*a*, a female with her batch of eggs; *b*, newly hatched larva—natural size indicated by the dot within the circle on the right; *c*, egg; *d*, *c*, vacated shells (after Riley).

Miss Corsaut's school exhibited a series of specimens of grasshoppers (Fig. 10) one or two with parasites attached, the red mite, *Trombidium locustarum* (Fig. 11), and a dissection of a locust.

It is to be hoped that an increasing number of county and township fair boards will follow the example of the Western in offering encouragement to the true study of insects in life. Collections of insects as commonly seen at county fairs have little claim to the honor of scientific exhibits. Their proper place is with wax flowers, rosettes of sea-weed, and other such pretty bric-a-brac. There is little scientific value in a collection of insects arranged at hap-hazard without notes and dates, be they ever so nicely spread. Economic interest in nine cases out of ten centres in the larval form of insects. Exhibits to be worthy of the name of science should attempt to show the phases of the life cycle, or at least something more than the mere capturing and preserving of a pretty object. The best prizes in the class ought to be offered for exhibits of complete representations of insects in their various stages. We should add to our extensive collections here such series of the more important economic insects, taking as a pattern this one of the gypsy moth[*] which shows so well the egg, larvæ, pupa and imago of that insect.

During the year I received several inquiries from teachers near and remote asking suggestions in the matter of directing children in the practical study of insect life. Anticipating that in the future others may desire the information, I avail myself of the opportunity afforded by the printing and circulation of this report, to gratify the desire more fully and satisfactorily than I could do by letter.

At the outset the purpose of the lessons should be clearly defined in the teacher's mind. The aim should not be to fill the learner's memory with knowledge about insects but to train the young eye to see and the mind to reason about, to connect and relate the phenomena observed and to make these observations and reasonings the occasion for practice in correct expression by voice, pen and pencil.

The study, if natural, will be attractive to children. Flowers and insects are the classes of objects, next to mud pies, that they take most delight in. Now I recall Wordsworth's lines :—

"Oh ! pleasant, pleasant were the days,
The time, when, in our childish plays,
My sister Emmeline and I,
Together chased the butterfly !
A very hunter did I rush
Upon the prey :— with leaps and springs
I followed on from brake to brush
While she, God love her ! feared to brush
The dust from off its wings."

In a recent biographical sketch of that eminent training-school principal, Edward Austin Sheldon, of Oswego, by his talented daughter, there occurs this passage :—"This latter book (Harris's 'Insects Injurious to Vegetation,') was quite a classic with my father and me. We would sit in an unfurnished room of our unfinished house with the light burning so as to attract insects in at the open windows. We would soon have a delightful collection of moths, beetles and flies which we caught, killed, and then tried to determine by comparison with his book—an operation in which my father found me an enthusiastic rather than a valuable assistant. This keen and special interest in insects came about from the fact that my father's own work in the young training school was for some time zoology, and he saw that with the masses of children, insects gave one of the easiest and most inviting entrances to the whole domain of organic life. This idea, however, cost him much persecution and ridicule from those who could not understand the connection between grasshoppers and a well-educated child, not knowing grasshoppers very well themselves."

Each teacher will as skilfully as he can, introduce the study. Plans to arouse an easily obtained interest will readily suggest themselves.[†] The main points may be illustrated by one or two examples and the technique rather than the methods may be described here. Take for example the cabbage butterfly, *Pieris Rapae* (figs. 7, 8 and 9) the study of which won the first prize above referred to. For a class beginning after midsummer holidays this insect is always easily obtained. Construct a cage by covering a box of horizontal cross section of from 40 to 100 square inches with mosquito netting or cheese cloth; or, being more convenient for feeding and studying, take an ordinary band-box, remove the bottom and substitute a netting or cheese-cloth covering. Use the latter to set over a smaller box such as a chalk-box. Many insects pass the pupal stage buried in the ground but chrysalids of butterflies are commonly found suspended in dry situations.

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[*] The speaker here exhibited a case received from the State Entomologist Fernald illustrating all the stages in the development of this destructive insect.

[†] Since writing the above I have received from Prof. Roberts. director of the College of Agriculture, Cornell University, Ithaca, N. Y., a series of seven "Teacher's Leaflets on Nature Study," entitled respectively : "How a squash plant gets out of the seed," How a candle burns, Four apple twigs, A children's garden, Some tent-makers, What is nature-study ? Hints on making collections of Insects. Some of the illustrations used in this paper are borrowed from leaflets Nos. 5 and 7. I can highly commend the series. The printer, W. F. Humphrey, Geneva, N. Y. is permitted to sell them to non-residents of the State at 5c. each or in large quantities at 1c. each. J. D.

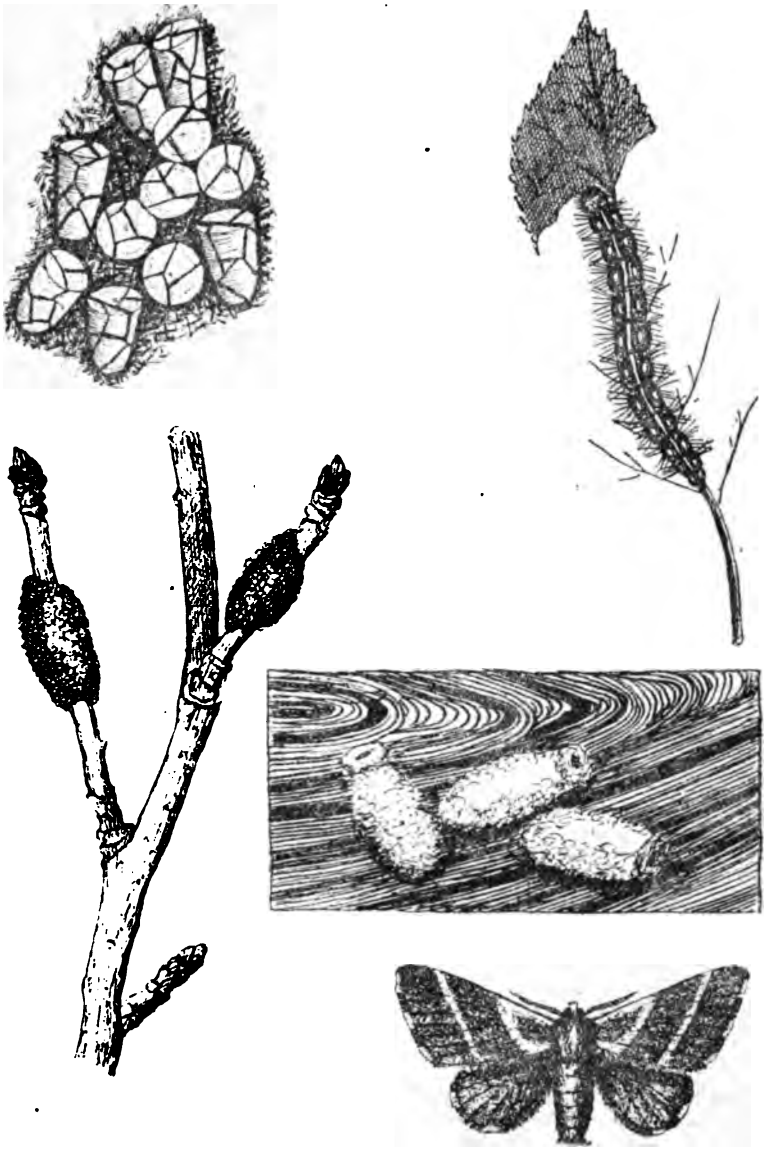

Fig. 12. Apple-tree Tent Caterpillar (*Clisiocampa Americana Harris*). Two bracelets of eggs on apple twig. Eleven eggs enlarged. A full grown caterpillar. Three cocoons under a chip. Imago of moth. (After Anna B. Comstock in Teacher's Leaflet No. 5.)

Earth to the depth of an inch may be put in the box and upon that some brushy twigs upon which to lay the leaves for food and chips to which the chrysalids may be attached. In the case of the cabbage worm, have the children collect the worms of various sizes and with them bring a leaf or parts of leaves to serve as food. If the supply of food is maintained the larvæ will eat voraciously, grow fast, and in a few days prepare to transform into pupae or chrysalids. When these are formed, in the example under notice the box may be set away in the wood-shed or other secure cool place until the following spring awaiting the final transformation. Will you await the delightful surprise to discover to the children the connection between the beautiful white butterfly and the green cabbage-worm, (figs. 7, 8 and 9) or will you lead them to discover it when they are collecting and observing the larvæ? Circumstances will determine. You can and should stimulate a search for the youngest and smallest specimens. Some pair of sharp eyes may trace one to the egg, attached alone by its end to the under side of a cabbage leaf. Then institute a search for eggs, these will be brought in numbers and the hatching studied. It is needless to say you should have a magnifying lens; every teacher should have one.

In the spring the tent caterpillar is very suitable for study. It is no trouble in the beginning of the season to find a bracelet of varnished eggs encircling a twig of apple tree or wild cherry, (fig. 12) cut off the twig with another attached so as to form a fork that the newly hatched insects may weave a tent upon it. Set two or three of these forks in bottles of water, to stimulate the growth of the buds so that when the eggs are hatched the young tent-makers may have some leaves to feed upon. In time transfer them to the breeding cage with chips resting on the earth, under these chips they will spin their cocoons. These cocoons may be given to the children to watch during the holidays, for before the 1st of September the moths will have emerged. The conditions of growth in the school-room may be so unfavorable that healthy cocoons are not formed; supplement the supply by out-door captures. These two examples are selected out of many that might be taken. Nothing has been said of the important part of the study—observations on the habits, moulting, organs, mouth, antennæ, legs, segmentation, etc. These should all receive due attention.

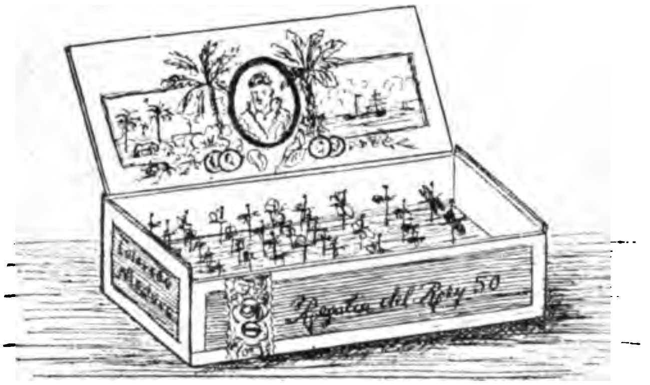

Fig. 13. In Teachers' Leaflet No. 7 (A. B. Comstock.)

When the moths are bred you may, if you wish, release them, but you may wish to preserve what represents a life history of the insect. Obtain a box 6 or 8 by 10 inches, 2 to 4 inches deep with a close wooden or glass cover, a cigar-box does very well for a beginning. (Fig. 13). Tack linoleum or cork in the bottom and then line the inside with white glazed paper. Two boxes similarly lined, hinged together, covered to resemble a large book and shutting very tightly are much used for insect cases.

The eggs are easily preserved. The leaf, twig, etc., may be pinned in the box, the eggs may be touched with coal oil to prevent hatching.

The larvæ are taken at various stages and killed with fumes referred to below or by dropping into hot water or into water and alcohol. They may be 'blown' as follows: snip off the anal end, empty by repeated gentle rollings with a lead-pencil from the head backwards, then blow up through a straw inserted in the opening, tie to keep the air in, and dry. Or they may be preserved in alcohol by putting them first into a 20 per cent. solution in water, the next day in a 40 or 50 per cent. solution, the next day into a 60 or 75 per cent. solution. They will keep indefinitely in a 75 per cent. or stronger solution. The more gradually the strength of the alcohol is raised the better the form and marking will be retained. If put at once into strong alcohol, soft bodied insects are shrivelled out of recognition.

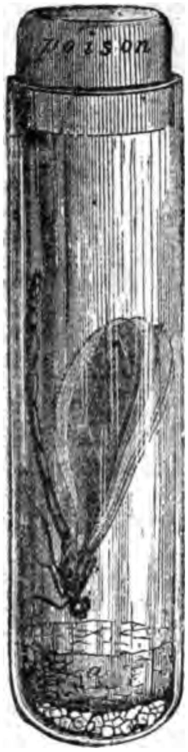

Fig 14. Cyanide bottle (after Riley).

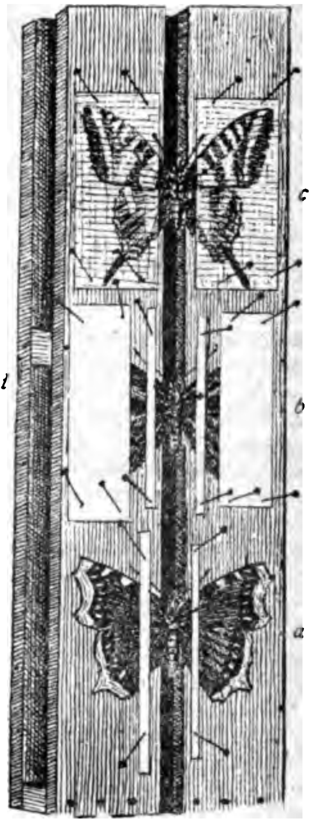

Fig. 15. A spreading board. The cleat *d* is one of two short ones that do not extend in far enough to interfere with the linoleum strip. Another should be shown at the upper end extending all the way across. (After Anna B. Comstock in Teacher's Leaflet No. 7; Coll. of Agric., Cornell Univ).

Frequently parasites may be discovered in or upon (living) insects. These should be carefully observed and specimens of them kept.

Butterflies and moths (*Lepidoptera* from *Lepis* a scale and *pteron* a wing, the wings being more or less covered with scales or microscopic feathers which give them their markings) whatever way captured, commonly with a net when in the open field, are transferred to a bottle or tin box and there killed with fumes of chloroform, ether, benzine, creosote, tobacco or cyanide of potassium. A cyanide bottle (Fig. 14) which should have a wide mouth and a tight cork, is prepared by dropping one or a few small lumps of cyanide of potassium, enough altogether to be as large as a marble, varying of course with the size of the bottle, pour over the lumps enough of a mixture of plaster of Paris and water of cream-like consistency to well cover the cyanide, or put in water enough to cover and add dry plaster of Paris enough to make a cement. Allow it to dry before corking. It is well to slip in strips of paper or a thin layer of cotton batting or discs of blotting paper or thin cork for the insects to rest on. Robertson's cyanide bottle described in the American Naturalist is constructed by putting some pieces of cyanide in a pill-box which can be inserted into the under side of the cork of the bottle or glued to it. The free side of the pill-box is perforated with pin holes. Keep tightly corked except when inserting or taking out an insect. To use chloroform, ether or benzine put a few drops on a bit of cotton batting and shut in box or bottle with the insect, or in like manner use a piece of cork saturated with creosote.

After killing, lepidoptera are spread on a board until dry. The spreading is easily done before the insect becomes rigid. To make a spreading board (Fig. 15) take two pieces of smooth soft board one-third to one-half inch thick and ten to eighteen inches long by two or three inches wide, tack them a half inch apart at one end, a quarter inch at the other to cross cleats; below the opening tack an inch-wide strip of linoleum, corky side upwards, from cleat to cleat.

Insert a pin through the body of the killed insect just behind the head; stick the pin into the linoleum so that the insect's body will be carried down to the wings through the opening between the boards. Carefully, so as not to brush the "dust" off the wings expand them on the boards and over or across them pin narrow strips of paper (Fig. 16) to keep them in proper position until they dry. Two or three days will suffice for the drying. Beetles should be pinned through the right wing-cover (Fig. 17).

In the box we have spoken of nicely arrange the preserved material—eggs, larvæ dried or in vials of alcohol, parasites if any, pupæ, moths, or butterflies, etc. Photographic sketches of three such preparations were published in last year's report opposite p. 32. Keep living insects out, first by having boxes which close and stay tight, second by keeping in them a camphor ball or crystals of napthaline. Above all take good care of your accurately dated notes of observations. One such box as this the results of the teacher's and pupils' own efforts and investigations is likely to prove of greater educational and practical value than memorizing a whole text-book on entomology even though such study were supplemented by catching at random and mounting hundreds of beetles, moths and butterflies.

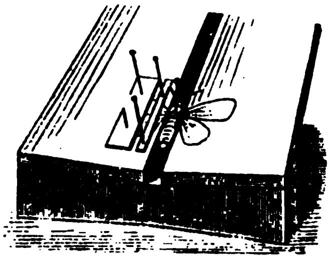

Fig. 16. Spreading board for butterflies and moths (after Riley).

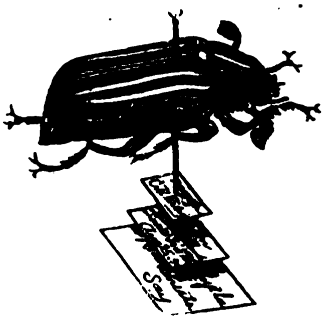

Fig. 17. Method of pinning and labelling beetles (after Riley).

One of the most serious defects in our public school system of education is the lack of exercises that train children to observe and to reason from their own observations. Such kind of training cannot be obtained from text-books nor tested by examinations, and hence will the more slowly gain its proper place. But I hope that the influential efforts of this society, now that it has taken the subject up, will continue to stimulate and encourage nature study in our schools, at least along that line in which it is particularly interested which the quotation from Mr. Sheldon shows to be so appropriate and which is no less practical than disciplinary.

Mr. Fyles, in moving a vote of thanks to the President, expressed the pleasure experienced by all who were present in listening to the address; he found it most interesting and full of valuable lessons to all.

Dr. Fletcher seconded the motion and said that he thought all had enjoyed very much the presentation of the affairs of the year that Mr. Dearness had given. For himself he considered the remarks in the address singularly pertinent. No branch of science meant more in actual dollars to the people of the country than that of entomology. Of all the crops that we grow, whether in the field, the orchard or the garden, at least one-tenth was lost owing to the depredations of insects, and yet to-day fewer persons applied themselves to this study than to almost any other branch of science. The strange thing is that so little is done to instruct children regarding their insect friends and foes. The plan proposed by the President in his address—the study of practical entomology in the rural schools, is an admirable one, and yet nothing has hitherto been done in Ontario in this respect. In Manitoba the rural schools are much in advance of ours; there the children are taught some practical entomology and botany, and are rapidly coming to know the insects and weeds that are giving trouble, and to recognize common plants and other objects. Children on the farm may, by a little instruction of this kind, save many false steps from being taken in the warfare against pernicious weeds and insects. Through his official correspondence he finds a vast amount of ignorance about these things that ought not to exist, and the only way to remedy it was by beginning with the young. He considered that the President's address was eminently practical and useful, because it treated of such common insects as the tent caterpillar and the cabbage butterfly. Knowledge such as this, if spread throughout the country schools, would mean the saving of hundreds of thousands of dollars. Take the San José Scale for instance, the most destructive insect yet known. How few persons could recognize it if they saw it! How few could tell it from the oyster-shell bark-louse! Who can answer the question as to its effect upon Canada? He believed that President Dearness was doing a great deal by this address, in spreading a knowledge of the work of this Society, and in popularizing the study of entomology. Turning to the reports of the Branches, which had been read, he drew attention to the fact that the Montreal Branch had held no less than 207 meetings, and of these probably 200 had been held in Mr. Lyman's own house, where he entertained the members and enabled them to make use of his valuable library and extensive collections. Few men had done such a good work for the science as this.

Dr. Bethune rose to put the vote of thanks to the meeting, and said that all present must highly appreciate the address of the President and heartily subscribe to the favourable comments which Dr. Fletcher had made upon it. He was glad to find that the President again took up the subject of teaching entomology in the rural schools, which he and Prof. Panton had brought before the annual meeting last year. It was satisfactory to learn that the Western Fair Association continued to offer prizes for the exhibition of life histories of insects by school children, and the good work presented showed that some of the schools at any rate appreciated the opportunity afforded them. With regard to the extraordinary disappearance of insects that were prevalent in immense numbers last year, he thought that there were two causes for their destruction, viz., the work of parasites and the very changeable weather during the winter. Mr. Moffat, last year, when the army worm was swarming all over the Province, predicted that we should not be troubled with it this year, and we all know how true his prophecy proved. We may ascribe its absence this year to the excessive mortality caused by its parasites and other natural enemies. Dr. Bethune then put to the meeting the motion for a hearty vote of thanks to the President for his excellent address, and pronounced it "carried" amid much applause.

The Rev. T. W. Fyles then read the following paper:

THE LOCUSTS OF THE BIBLE.

REV. THOMAS W. FYLES, F.L.S., SOUTH QUEBEC.

Solomon, the favoured of God, who lived in the golden age of Israelitish history, was renowned as a wise ruler, an enlightened philosopher, a gifted poet. He was moreover a distinguished naturalist, for it is told in his praise that "he spake of trees, from the cedar that is in Lebanon, even unto the hyssop that springeth out of the wall; he spake also of beasts, and of fowl and of creeping things, and of fishes."*

We may infer then that a knowledge of Natural history is not unbecoming in the man of position, the man of affairs, the gentleman, the scholar.

Such knowledge was needed in Solomon's days, for amongst the Baalim worshipped by the heathen around, and too often by Israel herself, was *Baalzebub*, the god of the flies, whose name was afterwards given to the Jewish devil. What bugbears have arisen in the minds of men ignorant of natural science!

Before Solomon's time the great Israelitish lawgiver, Moses, had paid much attention to the economic aspects of entomology, and by sacred writers in other periods of the history of God's ancient people thoughtful allusions, inculcating important lessons, were made to insect life and habits.

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* I Kings iv. 33

In studying these references and their teaching, we have to encounter great difficulties arising from the fact that between the science of the ancients and that of our own day there is but little connection. Most of Solomon's wise sayings in natural history have passed into oblivion. The reasons for the discrimination made by Moses in regard to food are unknown. The treasury of Egyptian wisdom that he drew from is gone, and generally, we have to form conclusions from obscure meanings of obsolete terms, and from statements made in highly figurative language.

Moreover, we have to fit the information thus gathered to a fauna with which we are imperfectly acquainted, and which exists under changed circumstances, and may itself have undergone changes both by losses and accretions.

Among the insects most frequently mentioned in the Scriptures, the locusts take a leading place. They are sometimes called grasshoppers, and they are often associated with "the caterpillar and the palmer-worm." It is of this army I purpose now to treat.

And first, for the better understanding of my subject, it may be well for us to take a glance at the modern systematic arrangement in which locusts and grasshoppers appear.

Both are found in that large order of insects named the ORTHOPTERA from two Greek words *orthos*, straight; *ptera*, wings. They are straight-winged insects.

By Westwood the Orthoptera were sub-divided into four groups which he named respectively *Cursoria*, *Graptoria*, *Ambulatoria* and *Saltatoria*; into

Runners, like the Cockroach.

Graspers, like the Mantis.

Walkers, like the Spectre Insect.

Leapers, like the Locust and Grasshopper.

The locust and grasshopper then are leaping straight-winged insects.

To set before you the points of distinction between them, that have come to be recognized by Naturalists in our own day, I cannot do better than make two brief quotations from Harris, whose work on "Insects injurious to Vegetation" is one of our Entomological classics. He says:—

"Grasshoppers, properly so called, * * are those jumping orthopterous insects, which have four joints to all their feet, long bristle-formed antennæ, and in which the females are provided with a piercer, flattened at the sides, and somewhat resembling a sword or cimeter in shape. The wing-covers slope downwards at the sides of the body and overlap only a little on the top of the back near the thorax. This overlapping portion, which forms a long triangle, is traversed, in the males, by strong projecting veins, between which in many of them, are membranous spaces as transparent as glass. The sounds emitted by the males, and varying according to species, are produced by the friction of these overlapping portions together." *Ins. inj. to Veg.*, p. 155.

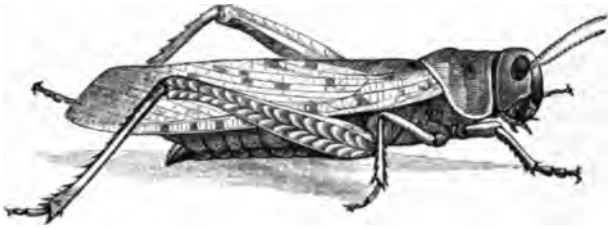

Fig. 18. A Grasshopper or Locust.

Again he says:—

"The various insects included under the name of locusts (Fig. 18) nearly all agree in having their wing covers rather long and narrow, and placed obliquely along the sides of the body, meeting, and even overlapping for a short distance, at their upper edges, which together form a ridge on the back like a sloping roof. Their antennæ are much shorter than those of most grasshoppers, and do not taper towards the end, but are nearly of equal thickness at both extremities. Their feet have really only three joints; but as the under side of the first joint is marked by one or two cross lines, the feet, when seen only from below, seem to be four or five jointed. The females have not a long projecting piercer, like the" * * "grasshoppers, but the extremity of their body is provided with four short, wedge-like pieces placed in pairs above and below." * *

"The males, though capable of producing sounds, have not the cymbals and tabors of the crickets and grasshoppers; their instruments may rather be likened to violins, their hind legs being the bows and the projecting veins of their wing-covers the strings. *Ibid*, p. 165.

Between the grasshopper and the locust then there are well-marked differences in structure, and in their methods of producing musical notes. But these differences have come to be recognized by naturalists in very modern days.

By the English generally both kinds of insects are still called grasshoppers. If I had been asked when a boy to tell the differences between them, I should probably have said, the locusts are creatures that we read of in the Bible and books of travel; the grasshoppers are those long-legged fellows that spring up before you when you walk through the grass.

We learn from Kirby and Spence that it was reported that a cloud of grasshoppers had enveloped a ship when it was distant 200 miles from land. Here locusts were certainly meant, for grasshoppers (as *we* understand them) are incapable of long sustained flight. And Hasselquist quoted by the same authors tells of "locusts *or* grasshoppers."

I have no doubt that with the translators of our English Bible "grasshoppers" and "locusts" were synonymous terms. The Hebrew word *Arbeh* is translated by them, in some places (as in Exodus X, Proverbs XXX, 27) LOCUST, in others (as in Judges VI, 5 and Jeremiah XLVI, 23) GRASSHOPPERS. And in the Prayer Book version of the Psalms—a version retained from the "Great Bible" of A.D. 1540—the reference in Psalm CV, 34, to the Plague of Locusts in Egypt reads thus,—"He spake the word, and the grasshoppers came, and caterpillars innumerable: and did eat up all the grass in their land, and devoured the fruit of their ground."

Again, for the better understanding of my subject I will ask you to glance at the life history of the locust as it is known to us. It is very much the same in all lands.

The mother locust when about to deposit her eggs makes an opening in the earth about an inch deep, using her abdomen as a drill. The horny plates at the extremity of her body which she can bring to a point for the penetrating of the soil, and expand for the widening ot the orifice made, enable her to work with facility. In the receptacle thus formed she lays a batch of eggs surrounding it with a frothy mucous which hardens into a protection against moisture. She then conceals the hole.

It is calculated that each female will deposit in the course of the season from 10 to 175 eggs.

In due time the young larvæ appear, and comical little fellows they are, largely made up of legs of which they have six. They are gregarious by instinct, and they have healthy appetites. They feed and grow, and cast off their skins when these become too tight for them—having more expansive ones beneath.

They have no wings; and when they march they take a few steps and then a jump,—a few steps and then a jump,—and so onwards. In Eastern lands where they abound, this mode of progression gives to their advancing multitudes a strangely undulatory and wave-like appearance.

With many kinds of insects the pupal state is a quiescent state—not so with the locusts. Their pupæ are both active and voracious. They cannot fly, but they bear the cases in which the wings of the future imagines are forming.

At length the time comes for the perfect insect to appear; the skin of the pupa splits along the back, and the imago extrudes itself, drawing its wings out of their cases, and its legs from theirs as if it were drawing off its boots. In a few minutes it is fully developed, and is ready for feeding, for pairing and for flight.

Our largest Quebec locust, *Œdipoda Carolina*, Burm., measures about three inches and a quarter in expanse of wings. The *Œdipoda migratoria* of Palestine is double that in size. But it must not be forgotten that the locust plague of Egypt was a unique and miraculous visitation. We are expressly told that "Before them there were no such locusts as they, neither after them shall be such.' They came on an east wind that had blown for a day and a night. Traditions concerning them must have lingered long, and probably gained in the telling; and so it is not, perhaps, very strange that Pliny the elder should have heard of locusts from India that had a length of three feet and legs so set with spines that the women used them for hand-saws. Men in Pliny's time could doubtless "draw the long bow" and listen, *auribus patentibus*, to travellers' wonders. In our day we tell *bear* stories, *moose* stories and *fish* stories. It seems that in Pliny's day they told *locust* stories.

I have in my collection a locust from the tropics which has an expansion of wings of nine inches, and its legs are four inches long. This formidable insect is hard, warty, and crested like a lizard, and its wings are of a dark blood-red. Fancy creatures such as this descending in "numbers numberless"—darkening the sky—tumultuous—bewildering—beating in your face—clinging to your hair and clothing—writhing under your feet—whirring, clattering, gnawing all around you—devouring everything eatable, and then in the rage of hunger falling upon one another.

The scene is too horrible. Yet it is one that has been often witnessed. The Tartars tell of men smothered by locusts.* And but a few months ago it was stated that a French explorer had been overpowered by locusts, and when the swarm lifted and men came they found *a skeleton*.

The Hebrew word ARBEH which, as we have seen, is translated *locusts* or *grasshoppers*, originally signified *multitudinous*. It is translated in the Septuagint *akris*; in the Vulgate *locusta*, and in Suker's German Bible, *henschrecke*. In Judges, VI. 5, and in Jeremiah, XLVI., our English translators rendered it *grasshoppers*. It is generally believed to have been the *Œdipoda migratoria*. The *wandering* locust according to modern term—the *swarming* locust according to the ancient appellation.

It was my good fortune to see and to capture several specimens of this interesting insect when I was a boy. After long-prevailing south-east winds, they had been brought, probably from Spain or Africa, to the east coast of England. Certainly I accounted it a noble creature, with its helmeted front and its wide-spreading, fan-like under-wings, which one might fancy to be formed of delicate green gauze. When it alighted its horny feet came down together with a clatter that was startling.

Another word is in frequent use in the Jewish Scriptures to denote locusts. It is CHAGAB, which is derived from a word that signifies to *veil* or *cover*—The swarms cover the earth and veil the sun. By our English translators Chagab is usually rendered *grasshoppers*; and in the connection in which it is employed it suggests the idea of *smallness*, as in Numbers XIII. 33: "And there we saw the giants, the sons of Anak, which came of the giants; and we were in our own sight as grasshoppers, and so we were in their sight." It became in the late Hebrew a collective name for the locust tribe (see Speaker's Commentary). It is thought to have been especially applied to the species *Acridium peregrinum*.

There is a third kind of locust quite common in the East, the *Acridium lineolum*.

One of the insects that the Israelites were allowed to take for food was the "Bald Locust" of our English Bible—the SALAM of the Hebrew. The latter term means *a consumer*. This insect is believed by Wood to have been a *Truxalis*, a kind of locusts with enlongated heads suggestive of baldness.

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* Kirby and Spence's Entomology, Letter VII.

Besides those words translated *locust*, *bald locust* and *grasshopper*, in our versions, there are others variously rendered which are yet believed to have signified locusts, either of different kinds or in different stages of growth

OHARGOL, the "beetle" of Lev. XI. 21, 22, is believed to have been some kind of locust for it is numbered among the insects that "have legs above their feet to leap withal." In connection with this, Wood, in his Natural History of the Bible, expressed a belief that there are no people that eat beetles; but in this he was mistaken. Dr. Hartwig says :—

"The Goliath beetles of the coast of Guinea are roasted and eaten by the natives who, doubtless like many other savages, not knowing the value of that which they are eating, often make a *bonne bouche* of what an entomologist would most eagerly desire to preserve."—*Polar and Tropical Worlds*, p. 592.

Of words that are supposed to denote the locust in an immature state, we have: —

CHASTIL, *the devourer*, translated "caterpillar" in 1 Kings, VIII. 37, 2 Chron. VI 28; Psalm LXXVIII. 46; Isaiah XXXIII. 4; Joel I. 4, and II. 25.

YELEK, *the feeder*, translated "caterpillar" in Ps. CV. 34, and Jer. IV. 14 and 27; and *cankerworm* in Joel I. 4 and II. 25, and in Nahum III. 15, 16.

Dr. Thompson gives a graphic description of a procession of these "caterpillar, locusts." He says :—

"Their number was astounding, the whole face of the mountain was black with them. On they came like a living deluge. We dug trenches and kindled fires, and beat and burned to death 'heaps upon heaps,' but the effort was utterly useless. Wave after wave *rolled up* the mountain side, and poured over rocks, walls, ditches and hedges —those behind covering up and bridging over the masses already killed. . . . It was perfectly appalling to watch the animated river as it flowed up the road and ascended the hill behind my house. . . . For four days they continued to pass on towards the east, and finally only a few stragglers were left."—*The Land and the Book*, p. 417.

This account will perhaps help us better to understand what is meant by "palmer-worm." In considering this a double difficulty faces us—the meaning of the original word GAZAM : the meaning of the English word *palmer-worm*. The latter certainly does not mean the *Ypsolophus pometellus*, Harris, of our Canadian lists.

GAZAM or GEZEM, the "gnawer," is rendered in the Septuagint *kampe* from *kampto*, to bend (as a caterpillar in motion). In the Vulgate it is translated *eruca*, and in the German *reupe*.

In Joel, I. : 4, we read "That which the palmer-worm (*gazam*) hath left the locust (*arbeh*) hath eaten." "Literally," says Pocock, "That which the *licking* (locust) hath left the devouring (locust) hath eaten."

The Seventy understood by GAZAM *something that progressed with undulations.*

The knowledge of the Eastern locusts and their ravages was no doubt spread amongst the English people by returned Crusaders and other pilgrims from the Holy Land. How would such men tell of a scene such as Dr. Thompson witnessed? They would probably speak of the immature locusts as caterpillars and describe their progressive movements as undulations. And the common people associating things described with things that were familiar to them would probably think of the devouring "processionary caterpillars"* of Europe which, like the "army-worm" of this continent, do incalculable injury.

At the close of the Crusades hordes of masterless, dissolute men, in passing through Europe on their return, must have devoured and wasted all they came upon, and yet were they proud of the cross and palm-branch, the tokens of their service. In irony, it may be—remembering the ravages of these men—the common people came to speak of gregarious, wandering caterpillars as *palmer*-worms; and so the English translators found a word ready coined and well fitted to represent *gazam*, the "waster," in *kampe*, the "scuffler."

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* *Cnethocampa processionea* and *Clisiocampa neustria.*

It is surprising what unsatisfactory definitions of such words as palmer-worm are given even in dictionaries of some note. In the "Dictionarium Brittanicum of N. Baily ('Philologus')," printed by J. Cox in MDCCXXX, we find "Palmer-worm, *a caterpillar with many feet.*" How many feet? Philologus seems to have thought that caterpillars had an indefinite number of such appendages. He evidently was not an entomologist. In "Reid's Etymological Dictionary" the explanation of palmer-worm is *a worm covered with hair.* What a wide field does this present for the student of languages to speculate in! He might say, Does the explanation denote a lizard, like the "slow-worm (*Anguis fragilis*)," but having a hirsute covering, or a serpent, like the "pretty worm of Nilus" that "kills and pains not,"* or a true worm belonging to the Entozoa or the Lumbrici?

Perhaps the simplest accurate definition that can be given to "palmer-worm" is *a wandering and destructive larva.* This would tally both with the English word and the original.

That locusts should abound in Palestine was natural. The inhabitants were a pastoral people. Around the cities were small tracts of cultivated land, but the country at large was wilderness. In the undisturbed soil the locusts would deposit their eggs in safety, and their progeny would grow and increase. The Francolin or Red Partridge might devour some of them; and dwellers in the wilderness like St. John the Baptist might make of them their bread, sweetening it with "honey out of the stony rock"; some of the insects might even be taken as delicacies for the feasts of kings, for in the British Museum is a sculptured scene of feasting brought from Nineveh, in which attendants are bearing locusts strung upon sticks in the manner that small birds were served in later times at the banquets of the Norman nobles. But such inroads would make but little impression upon their hosts, and at length they would arise in their strength—God's great army—directed by Him "who maketh the clouds His chariot and walketh upon the wings of the wind."†

Many stories are told of calamities brought by locusts. These are specimens, and they have a bearing upon what has already been said:

"From 1778 to 1780 the whole empire of Morocco was so laid waste by swarms of these insects that a dreadful famine ensued. Mr. Barrow, in his travels, states that in the southern parts of Africa the whole surface of the ground might literally be said to be covered with them for an area of nearly 2,000 square miles. When driven into the sea by a north-west wind, they formed upon the shore, for fifty miles, a bank three or four feet high; and when the wind was south-east the stench was such as to be smelt at the distance of 150 miles. Major Moore observed at Poonah an army of locusts which devastated the whole country of the Mahrattas, and most likely came from Arabia. Their columns extended in a width of five hundred miles and were so dense as to darken the light of the sun. It was a red species (not the common *Gryllus migratorius*), whose bloody color added to the terror of their appearance."—*The Polar and Tropical Worlds*, p. 589.

But no merely human account can approach the sublimity of the inspired description of a flight of locusts given by the prophet Joel—a description marvellous for the richness of its sustained metaphor and the splendor of its hyperbole.

The prophet sounds the alarm:

JOEL II.: 1. Blow ye the trumpet in Sion, and sound an alarm in my holy mountain: Let all the inhabitants of the land tremble: for the day of the Lord cometh: for it is nigh at hand.

2. A day of darkness and of gloominess, a day of clouds and of thick darkness, as the morning spread upon the mountains: a great people and a strong: there hath not been ever the like, neither shall be any more after it, even to the years of many generations.

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* *Antony and Cleopatra*, Act V., Scene II. †Psalm CIV., 3.

Then he tells of the damage:

3. A fire devoureth before them: and behind them a flame burneth: the land is as the Garden of Eden before them, and behind them a desolate wilderness, yea, and nothing shall escape them.

He portrays the foe:

4. The appearance of them is as the appearance of horses: and as horsemen, so shall they run.

5. Like the noise of chariots on the tops of the mountains shall they leap, like the noise of a flame of fire that devoureth the stubble, a strong people set in battle array.

He speaks of the terror they excite:

6. Before their face the people shall be much pained: all faces shall gather blackness.

He describes the assault:

7. They shall run like mighty men: they shall climb the wall like men of war: and they shall march every one on his ways, and they shall not break their ranks:

8. Neither shall one thrust another: and they shall walk every one in his path: and when they fall upon the sword, they shall not be wounded.

9. They shall run to and fro in the city: they shall run upon the wall, they shall climb up upon the houses: they shall enter in at the window like a thief.

Then he recapitulates:

10. The earth shall quake before them: the heavens shall tremble: the sun and the moon shall be dark, and the stars shall withdraw their shining:

11. And the Lord shall utter His voice before His army: for His camp is very great: for he is strong that executeth His word: for the day of the Lord is great and terrible: and who can abide it?

And then he gives the lesson:

12. Therefore also now, saith the Lord, turn ye even to Me with all your heart, and with fasting, and with weeping, and with mourning:

13. And rend your heart and not your garments, and turn unto the Lord your God: for He is gracious and merciful, slow to anger, and of great kindness, and repenteth Him of the evil.

Irresistible indeed is He who holdeth all things in His keeping, who can marshal the base things of the earth to confound the mighty, and things that are despised to bring to naught things that are. The nations well may tremble when He gathereth His great army, the locust, the caterpillar and the palmer-worm, to make the fruitful lands barren for the wickedness of them that dwell therein.

Mr. Harrington said that he was much interested in the paper which had just been read. Residents of northern temperate regions like Ontario could form little idea of the vast numbers of locusts which visited south-eastern Europe, and parts of Asia and Africa. Dr. Sharp, in a volume of the Cambridge Natural History, stated that in bulk the insects in existence in the world exceeded all other forms of animal life put together, and mentioned in illustration a swarm of locusts that was seen passing over the Red Sea in November, 1889. It was estimated to extend over two thousand square miles, and taking the weight of each individual locust at one-sixteenth of an ounce, the whole swarm was calculated to weigh the enormous amount of 42,850 millions of tons! The steamship from which it was observed, was sailing beneath the swarm at the rate of twelve miles an hour in the opposite direction and took between seven and eight hours to pass from under it.

Mr. Law spoke of the light thrown upon God's dealings with man by Mr. Fyles's paper and expressed the pleasure with which he had listened to it.

The President next called upon the Directors to report upon the insects of the year that had been worthy of note in their respective localities.

Mr. Harrington, the Director of Division No. 1, gave the following account of the season at Ottawa :

NOTES ON THE INSECTS OF THE YEAR 1897.

By W. Hague Harrington, F.R.S.C., Ottawa.

The climatic conditions obtaining during the past winter were evidently unfavorable to many insects. Intense cold during periods when there was but a scanty snowfall, alternating with decided thaws, caused extensive injury to many species of plants, and must have, in some degree, similarly affected insect life. The unfavorable winter was followed by an unusually wet spring, with frequent and violent rain storms, which undoubtedly destroyed myriads of our winged foes and friends, whose brief lives are frequently prematurely ended by heavy showers and storms. As a result, apparently, of this inclement weather there was, in the vicinity of Ottawa, a marked scarcity of the larger hymenoptera, especially of bees and wasps, the number and strength of whose colonies are dependent upon the survival of the fertilized females, and their ability to provide food for the first brood. This scarcity of macro-hymenoptera was clearly noticeable all summer ; very few of the larger ichneumonidæ, etc., being observed, except species which, like Thalessa, are parasitic upon wood-eating larvæ, and are thus not affected materially by unfavorable weather. Even in autumn, when the Spiræas and Goldenrods generally swarm with Crabro, Andrena, Halictus and many allied genera, comparatively few species and individuals were observed. The minute parasitic forms were obtainable in moderate numbers, but many species usually abundant were not met with, especially such as appear in the early summer.

As regards the occurrence of injurious insects there is but little of importance to mention. The copious rains, while destroying many insects, produced such a vigorous plant growth, that the foliage became too luxuriant to be much injured by any ordinary manifestation of insect life. The ravages of leaf feeding insects were therefore but seldom noticeable, and the foliage during the summer maintained an unusual freshness and plentitude. The only noticeable exception to the general scarcity of phytophagous insects was the appearance of great numbers of the tent caterpillars (*Clisiocampa*) Fig 19, which were more abundant and destructive than for many years. Early in spring their webs were seen disfiguring the neighboring woods, and occasionally the city shade trees, and as the larvæ increased in size, the unsightly webs became still more conspicuous among the defoliated branches. Many kinds of trees suffered from this infestation, but the most extensive operations were upon poplars, of which large areas were in some districts so defoliated as to have the appearance of having been scorched by fire passing rapidly over them. During July the newly emerged moths (Figs. 20 and 21) appeared in countless thousands, and in the city were a source of much annoyance, and some little personal discomfort. They swarmed so at night around the electric arc lights,

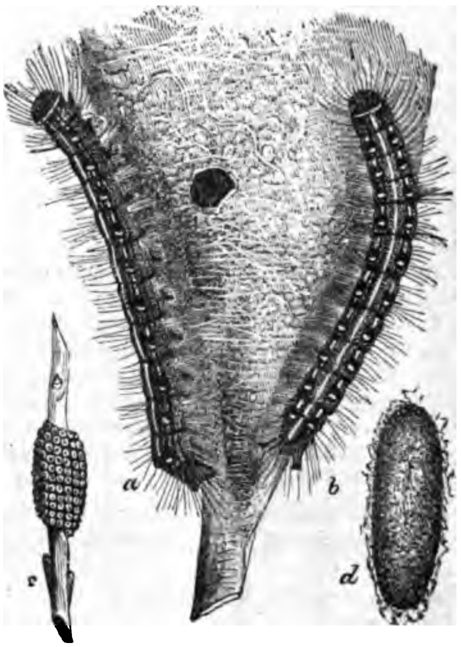

Fig. 19.

that the air seemed literary filled with them, and in their flight they dashed against pedestrians most unpleasantly. The pavements were almost covered by those which kept falling to the ground, and at every footstep a most unpleasant crunching of moths was experienced. Upon illuminated buildings, especially upon shop windows, they fluttered and crawled in myraids, and they dashed into every open window or doorway. The plague lasted for some days, during which an immense number perished in the arc-lamps and in other ways. The tent caterpillars are among those insects but little affected by climatic changes. The clusters of eggs (Fig. 19, c.) encircling the twigs are protected by a waterproof varnish-like secretion, and the caterpillars as soon as hatched proceed to spin the web which serves to protect the colony against the weather's vicissitudes, and to some extent from various enemies. Their parasitic enemies, however, are numerous and watchful and find opportunities to infest many of the caterpillars, so that the increase of the species is checked and eventually stopped, and an unusual abundance one year may be followed the next season by a comparative scarcity.

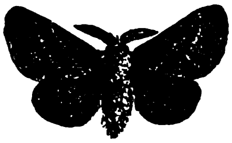

Fig. 20, Male Moth.

(*Clisiocampa Americana.*)

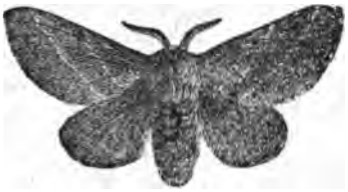

Fig. 21, Female Moth.

(*Clisiocampa Americana.*)

Dr. Bethune, the Director for Division No. 2, was next called upon to report:

NOTES ON THE SEASON OF 1897.

BY THE REV. C. J. S. BETHUNE, PORT HOPE.

Collectors of insects throughout the Provinces of Ontario and Quebec have, with few exceptions, pronounced the season of 1897 an "off year" as far as the capture of specimens was concerned. The scarcity of many common species may no doubt be largely attributed to the character of the preceding winter, which was remarkable for its sudden changes from mild weather to extreme cold and the frequent thaws which occurred. These great and rapid alternations of temperature are usually very fatal to any insects whose winter quarters are exposed or near the surface of the ground. But not only was the winter a trying one for insect life, the spring was for the most part cold and wet, and summer, coming very late, brought little fine or hot weather; with the exception of some ten days of intense heat during the early part of July, the season was characterized by a series of heavy rains and frequent storms. Seldom, therefore, has there been a season when the climatic conditions were so unfavorable for the healthy development of most kinds of insects, and seldom a season when the entomologist has had so little to record.

The most serious outbreak of the year was that of various species of Aphides (Fig. 22), which appeared in countless numbers on all kinds of trees and plants, and in many cases wrought serious damage. Currant bushes seemed to suffer the most, and before the summer was over had lost all their leaves. Cherry, plum, apple and other fruit trees were injuriously affected, and in the flower garden roses, herbaceous plants and annuals were severely attacked. The cool, damp weather that prevailed during the summer was especially favorable to the multiplication of these tiny creatures, and so numerous did they become that in the month of October and on sunny days in November the air was filled with winged specimens to the great discomfort of everyone out of doors and to the especial annoyance of bicyclists, whose eyes

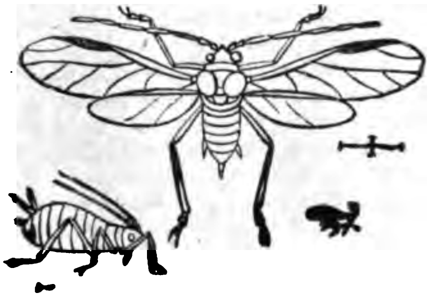

Fig. 22. Winged and wingless forms of Aphis—much magnified.

became filled with them. This superabundance of aphides was widespread over large areas in Ontario, and extended to several of the neighboring States, much damage being done by them in New York, Ohio and Michigan.

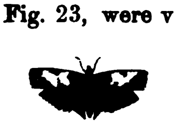

Fig. 23. Eye-spotted Bud-moth and larva.

In the month of May the larvæ of the Eye-spotted Bud-moth (*Tmetocera ocellana*) Fig. 23, were very abundant on plum trees in this neighborhood, and did a considerable amount of damage. This tiny insect has often been noticed in our annual reports and is no doubt familiar to most fruit growers in this Province and Quebec. It attacks the opening buds of apple, pear and cherry as well as plum trees, by eating through the leaves and forming a habitation for itself in the tender foliage, which it draws together and lines with silk. In this protecting case it continues to grow and consume the surrounding leaves, and often destroys in this way a whole cluster of blossoms or young fruit. When abundant, as it was this year, it does a very considerable amount of damage. The caterpillar is of a dull greenish-brown color, with a few short hairs on its body, proceeding from minute warts; the moth (Fig. 23) is a pretty little creature, ashen-gray in color, with a broad white band of irregular outline across the fore wings, and a black eye-like spot formed, when the wings are closed, at the outer margin of the band. From this it evidently derives its specific name. The insect can, no doubt, be kept under control by an early spraying of the trees with Paris green in the usual manner, and by plucking off and crushing the clusters of leaves containing the caterpillars.

Last year I mentioned the reappearance of the Apple-tree tent-caterpillar (*Clisiocampa Americana*, Harris). In the latter part of May this year, I found several of the tents, or webs, on apple trees and promptly destroyed their inmates. During the month of June the moths were somewhat numerous, coming into the house at night and bouncing about the lights in their usual blundering manner. We may expect that this troublesome insect will again become abundant and cause great damage to fruit trees unless their owners are on the alert in the spring and at once destroy all egg-bracelets (Fig. 19, *c*) that they can find, and the nests of caterpillars in their early stages before they scatter over the trees. Wild cherry and plum trees should especially be watched, as they form a favorite breeding ground for the insect.

While the web-forming caterpillars of the spring are thus on the increase, it is very remarkable that the Fall web worm (*Hyphantria textor*) should have been scarce last year and entirely absent this year about Port Hope. Though no observations have been made, it seems evident that the destruction of this insect is due to the work of parasites, as it has been a gradual process, extending over more than one year. If the extermination had been caused by climatic influences—by the alternate freezing and thawing during the winter—it would have been a sudden destruction, the work of a single season. A similar disappearance of a common species has taken place in the case of the Tussock moth (*Orgyia leucostigma*). I did not see a single caterpillar of this species in my garden this year and observed only one moth. In Toronto, where it was so very destructive last year, it was noticeable here and there throughout the city and some trees were partially defoliated by it, but there was no widespread injury and consequently no public alarm occasioned by it. During the preceding winter the Park Commissioner, under instructions from the City Council, destroyed an enormous number of the cocoons of this insect, the sum of $1,000 having been spent in paying boys for collecting them. As all the cocoons collected were destroyed without discrimination, the wisdom of the proceeding is somewhat doubtful; myriads of useful parasites must have been put an end to as well as the pupæ of the noxious moth. It would be well in future cases of the kind to entrust the collected material to an entomologist with instructions that he should keep all parasitized cocoons till the summer following and permit the inmates to escape, and burn all the rest. Dr. Howard, United States Entomologist at Washington, has recently published a most valuable and interesting pamphlet entitled, "A Study in Insect Parasitism," in which he gives an account of a severe attack by the tussock moth on the shade trees of Washington in 1895. Very large numbers of the cocoons were collected and it was found that over ninety-eight per cent. of them were parasitized, only two per cent.

being free from the attacks of these destroyers. In 1896 the tussock worms were few in numbers, as might have been expected from such wholesale destruction, and did little injury to the trees, but this year they have increased in numbers again owing to the destruction of the parasites themselves by others which prey upon them—secondary parasites, as they are termed. Thus was verified the old rhyme:

> " Big fleas have little fleas to bite 'em.
> And so on ad infinitum."

The " Army worm " (*Leucania unipunctata*) which was so abundant and did so much damage throughout this Province and the neighboring States last year, was, as Mr. Moffat predicted, conspicuous by its absence this year. As far as my own observations are concerned, I did not see a single caterpillar and not more than half a dozen of the moths, nor have I heard of any injury being done by the insect in any part of the country. This immunity is undoubtedly owing to the friendly work of parasites, especially the Tachina flies mentioned in the Report for last year.

The Grape-vine Flea-beetle (*Graptodera chalybea*) [Fig. 24], has been very destructive of late years to the foliage of the Virigina Creeper (*Ampelopsis quinquefolia*). Where spraying with Paris green was not resorted to several times during the season, the vines were completly stripped of their leaves before the end of August. Strange to say, a grape-vine against a fence only a few yards from some badly affected creepers was not attacked at all.

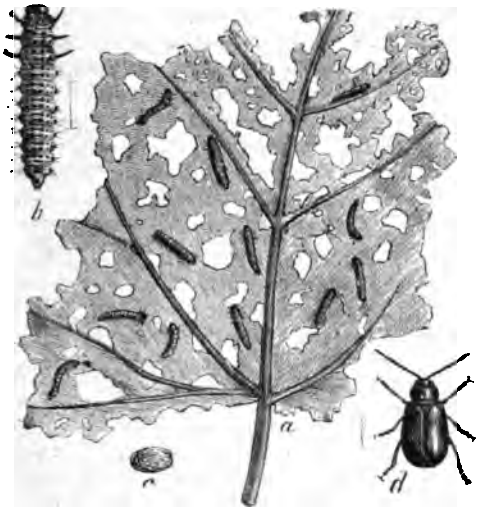

Fig. 24.

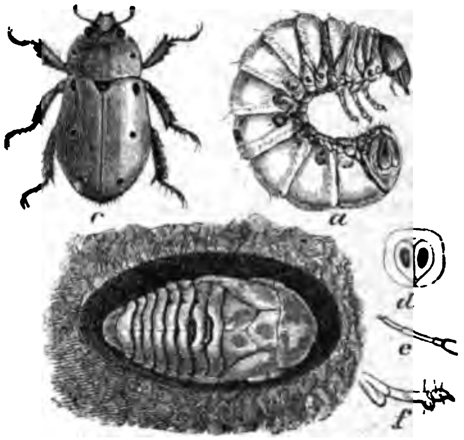

Fig. 25.

Among the interesting records of the year may be mentioned the capture of a specimen, for the first time at Port Hope, of the Spotted Pelidnota (*P. punctata*, Linn.) [Fig. 25], which feeds upon the grape-vine. I have never before met with this insect east of Toronto, but Mr. Evans tells me that he has taken it at Trenton. A specimen of *Papilio Marcellus* was again seen in the town park on the 24th of July—the same locality where it had been observed last year. Several species of *Plusia* have been common throughout the summer, visiting flowers in the day-time and attracted indoors by light at night, and have continued until late in the autumn; *P precationis* and *simplex* [Fig. 26], were the most abundant, and several of the rare *P. biloba* were captured, one as late as November 5th, when it was found sipping nectar from the few hardy flowers left in the garden.

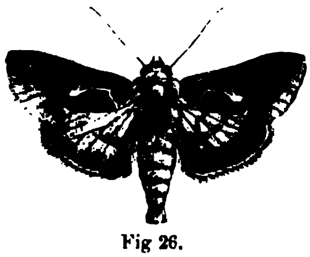

Fig 26.

Dr. Fletcher upon being called upon by the Chairman, gave a full and interesting account of the appearance of the

San Jose Scale in Ontario, and the measures that had been taken to counteract it (See his paper on this subject, page 78). He stated that the tent caterpillars were so abundant at Ottawa, as mentioned by Mr. Harrington, that they actually starved themselves out by stripping the foliage of the trees that they infested. He did not think that they would be as numerous next year in consequence of the destruction of large numbers by parasities and the fact that many of the females were infertile and laid no eggs. The larch saw-fly had re-appeared in Eastern Ontario, but the currant saw-fly had been quite infrequent. Cut worms also were not so abundant as usual; for them the best remedy is a mixture of bran, sugar and arsenic, which should be placed, a teaspoonful in amount, at the base of the corn-hills, or at intervals between the rows where seeds have been sown in the spring. He found that the cut-worms would eat this mixture just as readily when dry, as when moistened with water, and with equally effective results. The fall webworm was not nearly so numerous as usual at Ottawa, but the aphides, as mentioned by Dr. Bethune, was excessively abundant and injurious. The leaf-hopper of the grape had been abundant in the east; it could be controlled most readily with kerosene emulsion. The horn-fly, which of late years had been such a plague to cattle, had now almost disappeared as an injurious insect, and was not so numerous as the Stomoxys, the common biting stable-fly.

The invasion of Ontario by the San Jose Scale was the next subject brought up for discussion. Dr. Fletcher spoke on the subject and read extracts from a letter he had received from Mr. Martin Burrell, of St. Catharines, and exhibited a copy of the poster which had been issued from the Central Experimental Farm at Ottawa, by direction of the Minister of Agriculture. The poster had been widely distributed to post offices, agricultural societies, etc., throughout the country and had attracted much attention. Both the Dominion and Ontario Governments were doing all they could to prevent the spread of the insect. He strongly advised that all purchases of fruit trees should be made from Canadian nurseries where the Scale had not made its appearance.

Dr. Fletcher then continued his remarks upon the insects of the year, upon which he had been speaking before the adjournment the preceding evening. The pea moth, which had been very injurious throughout the country during the last few years, he had at length succeeded in breeding, and had brought specimens for exhibition at the meeting. He had also bred the apple fruit-miner, which bores in all directions through the fruit; specimens of this fruit were exhibited. *Selandria media*, which bores into the top of rosebuds, had been successfully reared and its life history worked out. He then gave an account of the rearing of *Erebia discoidalis* and *Brefos infans*.

Mr. Harrington asked whether all trees infested with the San Jose Scale should be destroyed. Dr. Fletcher replied that a badly infested tree is not worth preserving. Experiments have been made of spraying with pure kerosene instead of the kerosene emulsion, but there was very great danger of killing the trees as well as the insects upon them:

THE WORK AGAINST THE GYPSY MOTH, 1897.

By A. H. Kirkland, Malden, Mass.

The committee having in charge the work of exterminating the Gypsy moth, in its annual report for 1896, recommended that the legislature appropriate the sum of $200,000 for the work of 1897. After several hearings before the legislative committees, in February the sum of $150,000 was appropriated. This sum being available comparatively early in the season a large force of men were set at work destroying the egg-clusters and preparing the worst infested woodlands for the summer operations. Over 1,000,000 egg-clusters, each probably containing from 300 to 500 eggs, were destroyed, 300 acres of infested forest land were cut over or thinned of trees, the ground cleared and rubbish burned. By the time the eggs hatched the greater part of the burlaps had been placed on the trees. Spraying with arsenate of lead was commenced as soon as the leaves developed and was continued until about the middle of June. The poison mixture was applied at the rate of 20-150 gal. water, and about three tons of ingredients for making arsenate of lead were used in this work. The season proved a very unfortunate one for spraying operations. In May there were, I think, twenty days on which rain fell, and in June sixteen. In many cases this nullified the effect of the poison to a great extent and necessitated respraying. But even under these conditions from 60 per cent. to 80 per cent. of the larvæ in infested sprayed woodlands were destroyed.

Spraying with the arsenate of lead has this year shown itself as one of the best and cheapest methods for controlling the increase of the Gypsy moth. The extremely wet season favored a rank growth of foliage; this gave the insects abundance of shade, and later a great part of the large caterpillars refused to come to the burlaps, but remained clustered in tree tops. This necessitated the expensive operation of climbing a large number of trees. The season seemed also very favorable to the growth of caterpillars aside from food considerations. The abundance of tent caterpillars and canker worms, as well as the Gypsy moth, during the past summer confirmed this view. Thorough attention to the burlaps, however, as the caterpillars matured, together with the climbing of trees and destruction of large numbers by hand, made a great inroad into the ranks of the insect. Active operations were not relaxed until all the nests had been laid, and large numbers of pupæ and few moths were destroyed by hand, thus preventing the deposition of a great many egg-clusters. In the summer work from 200 to 366 men were employed. By the time the moth ceased laying our funds ran short, 125 men were discharged and the wages of others reduced. Later, to diminish expenses still further, the entire force was laid off for two weeks. At present writing, a careful search is being made of some outlying districts, while in the inner towns a force of men is at work treating nests. As soon as the leaves have fallen the work in the outlying towns will be prosecuted, so far as means permit.

Results of the Year's Work.

The results of the year's work may be summarized briefly as follows: The increase and spread of the Gypsy moth has been well controlled, and there has been less stripping of trees throughout the whole infested region than ever before. In the outer towns marked progress has been made towards extermination. The number of outlying colonies has never been so small as at present, and the infestations of the territory included within the border of the infested region were never so well known. The number of insects taken this year in the existing outlying colonies is much smaller than that of 1896. For example, in one of the Brookline colonies about 15,000 larvæ were destroyed in 1896, where but 191 were found in the same place the past summer. While much good work has been accomplished in the outer towns, it is apparent that the moth has increased near the centre of the infested district. The results of a hasty inspection indicate that the numbers of the moth have increased in Malden and vicinity.

Considerable areas of woodland in the large Metropolitan Park system are known to be infested, but their condition, on the whole, is better than that of last year. The destruction of the eggs previously mentioned prevented the increase of the insect in the woodlands. Owing to the amount of travel through the parks this infestation will menace the surrounding region, until funds permit the prosecution of exterminative work in the parks.

What is Needed.

So far we have been unable to burn the candle at both ends. With insufficient means we cannot carry on exterminative work over the whole region. Either the outside or inside territory must be neglected to a certain extent. To restrict the border line of infestation has seemed to be a matter of vital importance to the success of the work, and we believe that the chief efforts must be devoted to the outer towns, and in the present state of finances, controlling measures are all that can be used in the inner towns. What is needed is a good financial backing for a few years, then we shall be able to reduce the size of our request for funds as the work ceases to be one of insect destruction and becomes more and more one of inspection.

That never since 1892 have we been able to carry out our complete plans is a continual source of discouragement. Mr. Forbush and Prof. Fernald have expended their best energies in this work. The non-salaried committee conducting the work have given freely of their time and attention. Conditions have been carefully studied and plans made, only to be hampered by lack of funds. We believe that the best possible use has been made of resources which have been placed at our disposal. If any of our friends or critics will show us how to do two dollars' worth of work for one dollar, we will then show them how to exterminate the Gypsy moth with appropriations of the size made in the past. There seems to be a growing feeling throughout the state, on the part of tax payers, that the people of this Commonwealth in protecting themselves from this insect are protecting as well the adjoining states, and, in fact the whole country. That this argument is a just one there can be no doubt, and should the insect be allowed to multiply in this region, the through traffic in freight and passengers, in a short time would probably distribute the Gypsy moth over the greater part of the country. Whether this consideration of the matter from the tax payers' standpoint will tend to reduce the size of the appropriations for our work this year is problematical. Two things are certain, we need more funds than we have yet had, and we need to just as great an extent the moral support of all who are interested in the eradication of one of the worst foes to agriculture and horticulture that has ever reached our shores from a foreign country.

ELECTION OF OFFICERS.

The meeting then proceeded to the election of officers for the ensuing year, with the following result (see page 2.)

It was moved by Dr. Fletcher and seconded by Mr. Evans, and resolved, that the library and rooms committeee be instructed and empowered to deal with matters pertaining to the library and collections, such as adding books and specimens, providing cases, &c., and to secure the proper heating, lighting and cleaning of the rooms.

The treasurer, Mr. J. A. Balkwill, read the following report of the receipts and expenditure for the year ending August 31, 1897:

REPORT OF THE TREASURER.

RECEIPTS.	
Balance on hand, September 1st, 1896..	$ 530 93
Members' fees	389 85
Pins, cork, etc	60 32
Government grant	1,000 00
Sales of "Entomologist," etc	133 37
Advertising	17 50
Interest	20 80
	$2,152 77

EXPENDITURE.	
Annual meeting and report	$ 219 08
Salaries	350 00
Insurance	28 08
Pins, cork, etc	47 00
Library	59 60
Rent	117 77
Printing	587 42
Expense acct. postage, etc	168 30
Balance on hand	575 52
	$2,152 77

We, the auditors of the Entomological Society of Ontario hereby certify that we have examined the accounts of the treasurer and find them correct, and that the above statement is in accordance therewith.

R. W. Rennie, }
Jas. H. Bowman, } Auditors.

London, October 8th, 1897.

The librarian and curator, Mr. J. Alston Moffat, read his annual report as follows :

REPORT OF THE LIBRARIAN AND CURATOR.

At the last annual meeting of the Society, negotiations were in progress with the directors of the Y.M.C.A. for a room in their new building ; these having been successfully completed, the property and business of the Society were moved thereto.

At a meeting of the local board it was authorized to engage assistance and have the removal accomplished with the least delay possible, as soon as the room was ready for occupation. Preparations were commenced, and with the assistance of Mr. Balkwill all the books and papers were packed into boxes of a convenient size for lifting, loaned by Secretary Saunders for the purpose, in sufficient numbers that all emptying and refilling during the transfer was avoided, proving a great convenience and saving of time. After considerable delay, final decision was arrived at to begin moving on Monday, the 16th November, and by the evening of the 19th everything was in the new room, but in terrific confusion. The transfer was made without loss or injury of any account and during most favorable weather.

The cabinets and book cases have been—according to my judgment—placed to the best advantage possible, consistent with the form and dimensions of the room, and to the procuring of the most accommodation for the work of the Society and its material on hand.

With the more conveniently situated location has come a large increase in the number of visitors, whilst much surprise and admiration has been expressed at the extent and beauty of the collections.

According to a resolution passed at the last annual meeting, the 27 volumes of the Annals of the Entomological Society of France have been bound and placed in position.

Besides those that are bound annually, a number of valuable publications that have been accumulating for the past three years were approved of by the President and bound, and thus made available to the members ; also a third series of the Butterflies of America, by W. H. Edwards.

The bound volumes received from governments and public institutions during the year were the following:

The annual report of the Geological Survey of Canada for 1894.
" " " " " 1895.
" " Department of Agriculture, Ontario, for 1895.
" " Bureau of Industries, Ontario, for 1895.
The report of the N.Y. State Entomologist for 1896.
The Smithsonian report for 1894.
" " 1895.

The 48th annual report of the Regents of the New York State Museum in 3 volumes, containing amongst other important matter, a description of the edible and poisonus fungi of N.Y., illustrated by 43 colored plates.

The proceedings and transactions of the Royal Society of Canada, for 1896.
The report of the California State Board of Horticulture for 1896.
The report of the Fruit Growers' Association of Ontario for 1896.
The eighth annual report of the Missouri Botanical Garden for 1897.
The United States National Museum report for 1893.
" " " " 1894.
The seventeenth annual report of the U.S. Geological Survey, in three parts, 1895-6.

It is possible to separate the genera of the family by the following method:

A.—Crickets with broad fore tibiæ.
  B.—Antennæ long and setaceous.

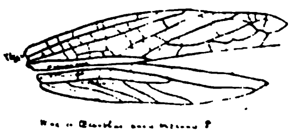

Fig. 27. Wing of Œcanthus angustipennis, female.

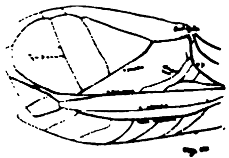

Fig. 28. Wing of Œcanthus angustipennis, male.

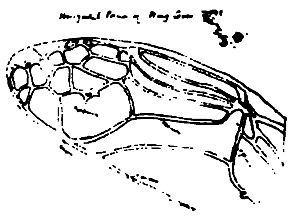

Fig. 29. Horizontal portion of wing-cover of Nemobius fasciatus, male.

    C.—Fore tibiæ with four spurs, *Gryllotalpa*.
    CC.—Fore tibiæ with two spurs, *Scapteriscus*.
  BB.—Antennæ rather short and filiform.
    C.—Body smooth; head horizontal, *Tridactylus*.
    CC.—Body velvety; head vertical, *Rhipiptoryx*.
AA.—Crickets with slender fore tibiæ.
  B.—Hind femora stout.
    C.—Apical spurs on hind tibiæ five and equal, *Anaxiphus*.
    CC.—Apical spurs six and unequal.
      D.—Last segment of maxillary palpi nearly same length as penultimate, *Gryllus*.
      DD.—Last segment of maxillary palpi twice as long as penultimate, *Nemobius*.
  BB.—Hind femora rather slender, *Oecanthus*.

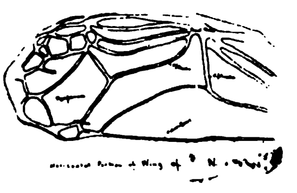

Fig. 30. Horizontal portion of wing cover of Nemobius vittatus, male.

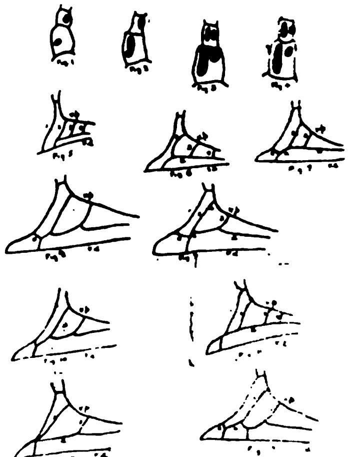

Fig. 31. Antennal marks and Harpa areas of Œcanthus.

VENATION OF THE WINGS.

H. de Saussure and J. Pungur have worked out a nomenclature of the veins in this family. That portion of the wing cover which assumes a vertical position on the side of the body is traversed by one large vein with its branches, the *Vena Radialis*, (Figs. 27-28). This vein sends out a large number of branches towards the outer border of the wing but none towards the inner. In the case of much shortened wing covers this vein is very much stunted and often only the branches are visible. The edge formed between the vertical and horizontal portions of the wing cover is composed mainly of the *Vena Ulnaris Anterior*; the other branch *V. Ulnaris Posterior* (Fig. 27), which is easily seen in the female is hard to detect in the male. The *Vena Dividens* is a well defined vein running along the outer border of the horizontal portion of the wing cover and anastomosing with the branches of the *Vena Plicata* which traverses the horizontal field (figs. 27-30).

The Vena Plicata in the female runs directly backwards giving out four to six branches which anastomose with one another forming a net work (Fig. 27). In the male the Vena Plicata runs directly, then bends at the first quarter of its length at a right angle toward the inner border where it forms the *Anal Node*, (Figs. 28-30). The part from the bend to the Node is the stridulating instrument. From the Node the vein continues in an oblique direction again to the outer border where it unites with the V. Dividens to form a knot—*the stigma.* In this way the V. Plicata bounds a triangular harp-shaped area in which several (0 to 5) undulating cross veins run—*oblique veins.* On the outside of the oblique part of the V. Plicata there is a confusion of veins which partly come from the Anal Node and partly from the V. Plicata so that in the last third of the wing there is a roundish area, the *Tympanum* or *Mirror* sometimes crossed by one or two cross veins. Behind the mirror lies a network of veins.

GRYLLUS.

Scudder in his materials for a Monograph of the N. A. Orthboptera enumerates six species, namely: *luctuosus, abbreviatus, angustus, neglectus, niger and Pennsylvanicus.* Following Scudder's descriptive remarks I have compiled the following synoptic table:

Species.	Color of Elytra.	Length of Elytra.	Length of Ovipositor.	Hind Femora.
			in.	in.
1. Luctuosus	black or brownish		.70	.45
2. Abbreviatus	dark, bordered with light brown.	covering abdomen	.74	.44
3. Angustus	like No. 2 but more slender		.64	.38
4. Neglectus	black or jet black	as long as abdomen	.56	.40
5. Niger		longer than neglectus	.45	.44
6. Pennsylvanicus	like neglectus		.45	

It will be apparent that the distinctions are based chiefly on the length of the ovipositor of the female which I found to be extremely variable. Moreover no method of identifying the males has been given. As far as the color is concerned it is of no value as a guide to species since it, too, is very variable. Saussure admits (Melanges Orthop. p. 317) that the species seem to grade into each other, and "it is impossible to define the limits of each. The accidental shortening of the wings already sufficiently embarrassing in itself seems often to become complicated with a shortening of the ovipositor. The color is very variable and it is impossible to settle on any character with certainty which can separate the species." The length of the ovipositor is made the chief character in distinguishing the two species of Saussure and Beutenmüller. I find in my collection all lengths from 10 to 21 mm., so here it is impossible to draw a limit.

Saussure gives the names *abbreviatus* and *luctuosus.* Under the former he places the varieties *neglectus* and *Scudderianus*, and under the latter he places the variety *Pennsyl-*

vanicus. Beutenmüller gives the names *abbreviatus* and *Pennsylvanicus*. Under the former he places the variety *angustus* and under the latter he places the varieties *luctuosus*, *niger* and *neglectus*.

An effort was made to separate the species of Gryllus by the aid of the wing venation but it was impossible to find variations which were constant. The number of oblique veins varies from three to five. The diagonal vein or vena plicata bifurcates to form the mirror which is more or less rounded. A transverse vein crosses the mirror. In all specimens examined the structure of the mirror remains practically the same; the transverse vein in some cases is rather faint. Beutenmüller states that *abbreviatus* has a much larger head and is more clumsy than *Pennsylvanicus*, but I fail to see any differences. One form *luctuosus* has long hind wings which project like tails behind the wing covers. This character is peculiar to both sexes. I see no reason why this character is not sufficient to delimit this form as a distinct species. We may then refer all the other varieties of the region to one species *abbreviatus*.

Fernald describes *abbreviatus* as follows: Black, elytra fusco-testaceous; veins testaceous; wings wanting; ovipositor as long as body.

The same author describes *luctuosus*: Black or brownish; elytra fusco-testaceous or black; wings extending to the end of the abdomen; ovipositor as long as the femur and half the tibia.

NEMOBIUS.

From the study of the tympanal areas of wing covers of the males of Nemobius I am unable to find any constant variation in the venation, so I am obliged to place all the members under one or two species by reference to plates. It will be seen that the harp area is traversed by only one oblique vein, that the tympanum is sometimes quadrate, sometimes more irregular, often with veins penetrating it and ending blindly. The degree of development of the apical part of the wing cover varies even in the same variety. The extremity of the wing cover is not prolonged but widely rounded, and the tympanum is thrown far back so that the apical area is very short and is composed usually of but one row of cells. The vena plicata bifurcates to enclose the tympanal area which moreover encloses two, sometimes three cells. (Figs. 29-30.) Saussure is unable to separate our forms by any constant variation in the tympanum and my studies confirm his conclusion.

As in Gryllus there is a form with long caudate wings. I would be in favor of limiting the species *fasciatus* to this form. The remaining forms would then fall into the species *vittatus*—the smaller forms making the variety *exiguus*.

ŒCANTHUS.

The specimens of Œcanthus collected about Ithaca, N.Y. and Windsor, Ontario, present many variations in venation, color, shape of wing and surface markings. They were collected during August, September and October, and the great majority of them were caught on Ambrosia artemisiæfolia (ragweed) and Euphorbia corollata (white spurge). A few were taken on grape vines, orchard trees and sumach. In color the specimens ranged from snowy white to almost black.

I have made an attempt to classify the species of Œcanthus according to the venation of a portion of the wing cover of the male. This is the portion called the *harpa* by Brunner. As will be seen by reference to a drawing of the wing cover of a male the vena plicata during the first quarter of its course forms the file or rasp. Extending in an oblique direction from the file are two or more veins more or less undulating which connect with the vena dividens. The file and oblique veins constitute the harp. Evidently the function of the oblique veins is to make tense the large vein to which they are attached.

The chirp of Œcanthus is a sexual call of the male to the female. It is natural to suppose that the females recognize the peculiar call of the males of the same species and cannot be lured by the calls of a different species. If such be the case then the peculiar sounds and calls must be produced by harps differing a little in structure, perhaps in the number of oblique veins or in the tenseness of these veins, that is whether undulating or straight.

The classification of the species is somewhat difficult. Several entomologists prefer to place all our native members in one species while some would make three or four. This question will remain in dispute till the life history of the genus has been thoroughly worked out and experiments have been made upon interbreeding.

Charles A. Hart of Champaign, Illinois, in an article in the Entomological News Vol. 3, 1892, page 33 divides the Œcanthi by means of black markings on the first two segments of the antennæ. These markings are very distinct and appear to be quite constant, and should they be discovered to be of functional importance are of great value as they are discernible by the naked eye, and easily outlined with the aid of an ordinary lens. In *Niveus* (Fig. 31, 1,) the markings are two black circular spots, one on underside of first and second segments.

In *Angustipennis*, (Fig. 31, 2,) the markings are a curved black line on first segment and a black oval spot on second.

In *Nigricornis*, (Fig. 31, 3 and 4) on the first segment there are a black longitudinal line, and a black spot exterior to it with similar markings on second segment. In some cases the markings are confluent at the upper part of the first segment.

Figure 31, 5 shows the venation peculiar to the harp of Niveus. The number of oblique veins varies from three to five, only the first two meeting the vena dividens. These undulate considerably and meet vena dividens at an acute angle. Oblique veins three, four and five extend parallel to one and two, but end in a second longitudinal vein (*d*.)

The venation of Angustipennis, (Fig. 31, 6) is remarkably like that of Niveus but there is a difference in oblique vein two. In Niveus it seems to extend from the vena plicata to vena dividens, but in Angustipennis it ends at the longitudinal vein (*d*) which is continued down to vena dividens.

The venation of *Nigricornis* (Walker) is decidedly variable, yet a study of the variations as in figure 31, 7-13 reveals a type which embraces all the forms. By far the largest number have the venation as shown in figure. By a reference to figure 31, 7-13 it will be seen that an additional cross vein has been developed between the oblique veins one and two, and which is marked (*e*) on figures. The migration of veins has been somewhat remarkable; in some cases a straightening has taken place so as to make one vein out of two as in figure 31, 11, where cross vein (*e*) and (*x*) portion of oblique vein two have been united into one line. In some cases (*e*) and (*x*) have become more inclined to each other as in figure 31, 10, while in other cases the oblique veins (1) and (2) have converged and united with the disappearance of veins (*e*) and (*x*) as in figure 31, 12. In figure 31, 8, (*e*) and (*x*) have begun to straighten; in figure 31, 9 oblique vein two has straightened itself. Usually there are only three oblique veins but occasionally a fourth is found as in figure 31, 5, 6 and 11.

KEYS FOR THE DETERMINATION OF THE SPECIES OF ŒCANTHUS.

I. Males.

A. Wing covers with a cross vein between the oblique veins 1 and 2 of harpa —*nigricornis*.

AA. Wing covers without a cross vein between the oblique veins 1 and 2 of harpa.

B. Second oblique vein extending to vena dividens—*niveus*.

BB. Second oblique vein terminating at longitudinal vein between VV. plicata and dividens—*angustipennis*.

II. Females.

A. Wings extending beyond the tip of ovipositor.
  B. Pronotum with a single mesal brown band—*angustipennis.*
  BB. Pronotum without a mesal brown band—*niveus.*
  BBB. Pronotum dark or with three bands—*nigricornis.*
AA. Wings not extending beyond the tip of ovipositor—*nigricornis.*

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* * *

A paper on *Drasteria erechtea* by Prof. F. M. Webster, illustrated with some very beautiful drawings, was read by Dr. Bethune.

A vote of thanks to the Treasurer and Secretary for their labours in the interests of the Society, was moved by Dr. Fletcher, seconded by Mr. Fyles, and carried unanimously.

Mr. Harrington, seconded by Mr. W. E. Saunders, moved a vote of thanks to Mr. Dearness the retiring President, for the interest he had taken in the affairs of the Society and his labour on its behalf. Carried unanimously.

During the meetings many rare and interesting specimens were exhibited by those present, among which may be mentioned a large number of moths obtained at electric lights by Mr. Bice of London, and the following, collected in the neighborhood of Quebec r Mr. Fyles and other members of the Quebec branch: *Phyciodes nycteis*, *Terias lisa*, *mnina exitiosa*, *Spilosoma congrua and cunea*, *Rheumaptera basiliata*, *Tetraphora stata*, and *Conops sagittarius*. Mr. Fyles also reported the capture of *Anarta melaleuca* id *Melipotis limbolaris*.

The meeting then adjourned, after a very profitable two day's session, during which uch enjoyable time was spent in the comparison of specimens, and in examining the any interesting books and cabinets belonging to the Society. All who were present :pressed their pleasure at the new quarters of the Society, which are so much more con- mient, as well as brighter and more comfortable than the former rooms.

THE VALUE OF SYSTEMATIC ENTOMOLOGICAL OBSERVATIONS.

By J. Alston Moffat, London, Ont.

Francis Albert Rollo Russell, Esq., Vice-President of the Royal Meteorological ociety, &c., &c., has this to say upon the influence of weather on insect pests:

"The effect of a particular kind of season on insect pests is worthy of more attention an it has hitherto received. The importance of attacking in time and as far as possible stroying the insect life which, if neglected, inflicts incalculable damage on crops and ardens, has scarcely been realized, owing to the blight being generally regarded as a cessary evil, not to be foreseen or prevented. The development of insect pests is enerally favored by dry weather. Stunting of the growth, and over maturation of the p of plants induce early changes in the maturing and structure of aphides; the insects ultiply without the interference of the ordinary destructive influences of bad weather, id delicate maggots, etc., which are generally drowned in very large numbers by storms rain, emerge unharmed. At the same time it may happen that corn and other crops ay be enabled by earlier hardening of the case, stalks, etc., to protect themselves against tacks which in wet years would bring serious damage. In some countries, and in respect some crops, it is customary to arrange the date of maturity with special regard to the otective power of the plant and the period of expected attacks from insects. The whole ibject is at present too little under scientific observation, and great benefit might result the following branches of inquiry were systematically investigated: (1) The influence different kinds of weather in developing insect pests; (2) the time of appearance of op insects in different seasons in relation to the weather, and the time at which crops e most open to attack in different seasons, according to the weather; (3) the treatment the ground in drought with a view to destroy threatening pests in their early stages, id, in general, the conduct of agricultural operations with regard to the probable develop ent of particular pests resulting from particular kinds of weather; (4) the issue of fore- sts of insect prevalence, derived from a careful study of the habits of various species of sect pests, and of the weather of present and previous seasons."

Everyone knows and admits the powerful and direct connection that exists tween the weather and the crops.

That the weather has a powerful influence on the propagation, maturation, multi- ication, migration and consequent spread of insect pests, is known only to those who ave given the matter some consideration. That some insects are in the habit of pearing periodically is a truth well established by observation, and that the weather ust affect these appearances can readily be inferred.

The weather of an extensive territory is often quite diverse in the different por- ons of that territory, and we can form but very little idea of the influences that are at ork, or where they may be at work, in producing the particular kind of weather cisting at any given time, in any given locality.

Lieut. Maury, U.S.N., in his magnificent work "The Physical Geography of the a," gives his reasons for believing that the great bulk of the precipitation on this ntinent is evaporated from the sea of the southern hemisphere. The meteorological observations inform us at times that a violent storm in the Gulf of Mexico is making itself felt in the Gulf of St. Lawrence. Such statements as these assist us in forming some estimate of the far reaching influences that may be affecting the weather of our particular locality.

The forecasts of the weather for the succeeding twenty-four hours, which we have become accustomed to regularly consult, and in good measure to rely upon, and which have proved to be of such immense value to multitudes in their everyday movements upon land or water, are not a matter of guesswork as some seem to suppose, but the condensed result of a vast amount of information gathered together into one central office from numerous distant stations, where it is examined and systematically arranged on purely scientific principles, before the probabilities are issued for the benefit of those living in the different regions into which the country has been divided.

The governments of various countries, realizing the advantage that would accrue to their people from a foreknowledge of what the weather would be for even one day, have established, at very considerable expense, stations all over their countries with suitable instruments for registering the atmospheric conditions and changes, with a competent person in charge to note these and transmit them by telegraph to the central office at stated times. The qualified meteorologist in charge of the central office or weather bureau receives these dispatches from all the separate stations far and near, and has to arrange, compare and condense the information thus obtained. Having been thus placed as it were upon an elevation from which he can survey the whole atmospheric movements that are going on all over the country at one glance, and being familiar with the laws that govern these movements, he has to make his observations from what they are at the present, as to what they are likely to be during the next twenty-four hours in the different regions into which the country has been divided.

For instance, he receives from a station hundreds of miles away information that a storm of a particular kind is raging there, the wind blowing in a particular direction, at the rate of so many miles an hour, he has to calculate by the rate it is travelling and its direction, at what particular time it will be likely to reach particular points along its course. But he may get at the same time information that hundreds of miles away in the opposite direction another storm is prevailing, which may throw the previous calculations completely out as he has now to take into consideration what influence the one will have upon the other, and if they unite what is the direction it will pursue, and whether with increased or diminished force. And so it is through the whole range of every condition and commotion of the atmosphere that exists at any particular place all over the country. Such a brief statement may help to show how thoroughly the weather bureau is under intelligent and scientific control, and that we may confidently rely upon its forecasts as proximately correct. And if the informing stations were increased in numbers, and the regions for which the probabilities are issued were reduced in dimensions they would be yet more reliable.

Now North America is getting to be pretty well dotted over with agricultural experiment stations, supported by government aid, for the benefit of the agriculturist and the general good of the country, and every well appointed agricultural station has an entomologist attached, whose duty is to report upon the depredations done by insects in his particular district, and the means taken to prevent or lessen the same, and bulletins are issued with more or less frequency giving the results of the work done by each, and the success obtained, partial or complete, or none as the case may be, and the probable reason for the same indicated.

Everyone who has the opportunity of seeing the quantity of literature of this description that is being issued from the various stations must be impressed with the industry exhibited in the investigations that are being made into the life and habits of insect pests, and the best means to be used in preventing their ravages. Now as each of these entomologists is in great measure working independently of all the others, and may not be informed as to the department that others are engaged in investigating until it appears in the bulletins of their respective stations, there cannot help but be a good deal of duplicating of each other's work going on, and as the seasons are short for some departments of this kind of work, and as attention must be given to it while the opportunity lasts, if the work is to be accomplished at all, many of them may not find the time for reading all that is necessary to keep them informed of what others are doing in a similar line. This fact has recently been fully stated by one who is himself well to the front in this kind of work, when he remarked that with the regular daily work of his position to attend to, it was utterly impossible for him to read all the bulletins that came to his office, and he requested as a favor, that any having matters of special importance that they wished him to see, should mark their papers so that he might not run the risk of losing the benefit of it. This statement discloses both the weakness and the needs of the entomological work that is being done in connection with the agricultural experiment stations.

The highest results in any work can only be reached by united effort under the supervision of one directing head.

With the apparatus and methods of the weather bureau before us, it seems easy to indicate a remedy for the present waste of time and energy that results from each individual entomologist pursuing his vocation with reference almost exclusively to his own locality, and with little information as to what others may be doing at the same time.

It would appear then as if the pressing need of the present system to complete its efficiency is a central bureau of entomological intelligence, with a person in charge appointed solely for his suitability for the position, and whose whole time could be given to the work of supervision. With such a permanent, central office established for giving and receiving information upon all manner of entomological subjects, we can easily understand how it would tend to unite the widely separated entomologists on the staff of the different agricultural stations, making them realize that they were not working alone though separate, and that each being kept informed of what the others were doing would in a measure reap advantages from the other's labors. And when one considers how much has already been done, largely by individual labors, we can form some estimate of how much more might be accomplished by well directed united effort under intelligent guidance. And as the regularly appointed entomologists increase in numbers, the greater will become the need for such a central systematizing bureau to prevent a waste of energy in duplicating each other's work, and that these will increase rather than diminish is certain, as the value of their labors is only now beginning to be realized, and the expense of their maintenance is being returned to the community a hundred fold.

It would be an easy matter to indicate how such a bureau should be conducted, but its ordinary work would be largely controlled by circumstances and necessities, as the course of events required. But it would be known to exist for the express purpose of receiving and disseminating all sorts of information about the doings of insects all over the country, and the best means of combating or preventing their depredations. Thus, the person in charge being kept fully informed of what was going on in the insect world, far and near, might be able to give warning of danger to one locality from what he had been informed was going on in another; and in the case of migratory insects, only such a fully informed person could indicate effective means of dealing with them, and in such a case, the meteorological and climatic conditions are of the first importance. He might even be able to issue forecasts of the probabilities for the coming season. We know what correct guesses Mr. Scudder made about the spread of the imported cabbage butterfly, from scant information gathered with great labor. I took my first Colorado potato beetle at Hamilton, about three years in advance of the time calculated for its appearance in that locality, indicating that the calculations had been made upon insufficient data.

Then there would be bulletins issued from this central bureau, with more or less frequency, as the circumstances required, which every entomologist would be sure to read, as they would be expected to contain a summary of the latest intelligenee of what was being transacted by, for or against the insect community all over the continent, or the world for that matter, which could not fail to prove of the utmost interest and advantage to every student in that line, whether he is economic, scientific, or recreative, and would keep each informed of what others were doing, and save in many instances an unnecessary expenditure of time and labor.

The information received at such a bureau need not be confined to that coming from the regularly appointed entomologists at the agricultural stations, but from every person who took an interest in the subject, and who had made an observation which he thought was worthy of reporting. Thus the sources of information would be increased, which are at present quite too few and widely separated. But we hope for a time when every town and district will have at least one intelligent observer to report for that locality. Then, how many curious, interesting and important questions of insect economy that long have, and still remain involved in mystery, will find a solution through the united systematic work of numerous observers? Thus, with those interested in the doings of insects at shorter distances apart, the east would be united to the far distant west, and the north with the south by means of this central bureau, and instead of our having bits of information about widely separated spots, as if they stood apart and alone, we would get an intelligent connected view of the various steps in the progress which unite the two extremes into one harmonious whole.

ON BUTTERFLY BOOKS.*

By Henry H. Lyman.

Having been asked by one of the members of our branch for advice on the books most necessary for one engaged in the study of the North American Lepidoptera, I have thought that this subject might be of sufficient interest to some of our other members as to render it not unsuitable for a short paper.

Hitherto I have always recommended anyone entering upon the study of North American insects to purchase Harris's Insects Injurious to Vegetation as the first and most necessary work upon the subject, and I recently noticed in a paper by Dr. S. H. Scudder, on "The Young Entomologist and what he wants," reproduced by the Montreal Witness, from the "Independent," that the writer gives the same advice saying, "the best single book is Harris's Insects Injurious to Vegetation."

If Harris's classic work no longer enjoys that unquestioned supremacy which it has held for so many years, the only work which may claim to rival it is Prof. Comstock's 'Manual for the Study of Insects," which has certainly some very valuable features, and is of course more modern and "up to date," though one may not agree with all the views set forth. I should certainly recommend both these works to everyone entering upon the study of entomology.

A smaller and much cheaper, but very useful work is Dr. Packard's "Entomology for Beginners." It serves as a general introduction to the science, treating of the "Structure of Insects," "Growth and Metamorphosis of Insects," "Classification," "Insect Architecture," "Injurious and Beneficial Insects," "Directions for Collecting, Preserving and Rearing Insects," with directions for dissecting insects, cutting and mounting microscopic sections of insects, and a list of the most important works on general entomology and the biology of insects, together with a glossary and index. Naturally with so much ground to be covered but little space could be given to the consideration of the different orders, thus only 24 pages are given to a review of the coleoptera, 20 to the diptera, 24 to the lepidoptera, 16 to the hymenoptera and 36 to the other orders.

To any one wanting a more extended guide for the collecting, rearing and preservation of insects, no better work can be recommended than Dr. Knagg's "Lepidopterist's Guide," which is issued at the moderate price of one shilling, and which though, of course, written for English collectors, will be found very useful by all, as its general directions and suggestions as to treatment are very generally applicable.

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* Read before the Montreal Branch of the Entomological Society of Ontario, 8th December, 1896.

When we turn from general works to those dealing with a single order, either in whole or part, the choice is more difficult and no one book is sufficient.

To any one who has the money to spend and who is interested in the butterflies of the whole continent north of Mexico, no finer work can be recommended than the magnificent volumes of Mr. Wm. H. Edwards on the butterflies of North America with their 152 exquisite coloured plates, but unfortunately the price, aggregating $135 for the three volumes, places the work beyond the reach of the great majority of lepidopterists.

For the butterflies of the Eastern United States and the contiguous parts of Canada, Scudder's splendid work leaves nothing to be desired, as it is a complete manual on the most elaborate scale of the butterflies to be found in the region, with a great wealth of illustration, but unfortunately its price, $75, puts it also out of the reach of very many.

An excellent work, dealing with almost the same territory but comprising about one-fourth more species and published in 1886, at a moderate price, is French's "Butterflies of the Eastern United States." This is a very useful work of 402 pages and gives descriptions of 201 species. The nomenclature and classification follow those of Mr. W. H. Edwards. Short directions are given for collecting, setting, preserving and rearing specimens, and there is an acccentuated list and an analytical key. The preparatory stages where known are described with considerable detail, and the distribution is given in a general way. There is, however, a dearth of illustrations, especially in the Lycænidæ and Hesperidæ.

A less pretentious but extremely useful work is Scudder's "Brief Guide to the Commoner Butterflies of the Northern United States and Canada," published in 1893, by Henry Holt & Co, at the very moderate price of $1.25. The author has selected for treatment 84 species which he judges would be almost surely met with by an industrious collector in the course of a year or two years' work in the Northern States east of the great plains and in Canada, but such as he classes as "rare" or occurring only in restricted localities are omitted. This, I think, is a pity, as no one starts out to collect merely common things however beautiful, and we all long for the rare and valuable. Besides, several are omitted which occur over wide areas, such as Grapta Gracilis, which is found in the Adirondacks, the White Mountains, in the Muskoka region, on the Lower St. Lawrence and even to the extreme end of the Gaspe Peninsula, and also Colias Interior, embracing a similar but apparently still wider distribution.

One great charm that I found in the acquisition of my first entomological work, viz, Coleman's British Butterflies, was that it treated of *all* the species found in Great Britain, and so I felt confident that whatever I caught I would find treated of there and it certainly seems to me that the few extra pages that would have been required for these species, even if their addition had slightly enhanced the cost of the book, would have been well worth the cost.

This book has no illustrations of any of the species, but though this is doubtless disappointing to the beginner, it has this advantage that when he has worked out the determination of any butterfly by the analytical key and the description he has a much more scientific knowledge of the species than if he merely named it by a superficial comparison with a good figure. The nomenclature, of course, is Mr. Scudder's own, the general adoption of which most of us, I think, would regard with disfavour. Otherwise the book has much to recommend it to the beginner.

Another work, of very limited scope but very beautifully illustrated, is Beutenmüller's "Descriptive Catalogue of the Butterflies found within fifty miles of New York City," published in the "Bulletin of the American Museum of Natural History," separate copies of which may still be obtained from the author at $1 each.

This work consists of sixty-eight pages and five plates, two by the Lithotype Printing Co. being especially fine. Ninety-three species are treated of and of these sixty-two are figured. Descriptions of the caterpillar and chrysalis are given where known, and the food plants and short notes on the life history. It is certainly to be regretted that this pamphlet is not more generally accessible.

"The Butterflies of Maine," published by Prof. C. H. Fernald in 1884, is an excellent pamphlet of 104 pages, describing the sixty-nine butterflies known to have been taken in Maine. It contains an accentuated list of the scientific names and the principal "common" names which have been given, and there is also an artificial key for the determination of the butterflies. There are no plates but there are thirty-five wood-cuts illustrating a number of the species in one or more stages.

For the Sphingidæ, the most important work is Prof. J. B. Smith's Monograph, published in Trans. Amer. Ent. Soc. XV., 1888, and obtainable separately at $2. This work extends to nearly 200 pages and is very exhaustive in its treatment. There are ten plates, eight devoted chiefly to the genital armature and two chiefly to venation, but there are no figures of species. About 30 pages are devoted to tracing the classification of the group from the time of Linnæus in 1758 down to the publication of this monograph in 1888. The preparatory stages are not described, but where known may be found from the references, which are very complete. This, however, has the disadvantage of compelling the hunting up of these descriptions in other works, which one may be unable to do if a complete entomological library is not within reach.

"The Sphingidæ of New England," published in 1886 by Prof. Fernald, is an excellent pamphlet of eighty-five pages and six plates, illustrating ten species, with the larva or larva and pupa of most of them. Forty-two species are described, and there is an analytical key and the scientific names are all accentuated and the work is on similar lines to the same author's "Butterflies of Maine."

"Descriptive Catalogue of the Sphingidæ found within fifty miles of New York," by Wm. Beutenmüller, is another excellent work on the same plan as his work on the butterflies. It consists of forty-six pages and six plates, which figure forty-two species, while forty-six altogether are described in the text. With such a work no one should have any difficulty in determining his specimens. This work was published in the Bulletin of the American Museum of Natural History, and except for the few author's separates is unfortunately only accessible to those able to consult this work.

For the groups intervening between the Sphingidæ and the Geometridæ there is as yet unfortunately no approximately complete work, nor indeed any work other than check list or catalogue at a moderate price.

In July, 1872, Mr. R. H. Stretch undertook the publication of a work entitled "Illustrations of the Zygænidæ and Bombycidæ of North America." It was to be issued in parts, each of which was to contain a coloured plate. The work was intended to extend to thirty parts at $1 each, or with plain plates 75c. each. The genera and species were not taken up in consecutive order but irregularly as specimens could be obtained, and as the work was discontinued after the issue of the ninth part, with which the author closed his first volume, it is very incomplete, and while rather costly in the first instance has become more so from its comparative rarity.

Dr. Packard has begun the publication of a sumptuous work, "A Monograph of the Bombycine Moths of America, north of Mexico." The first volume, which is all which has so far appeared, treats of the Notodontidæ, and costs $15 in paper covers, or $16 bound in cloth, and is, therefore, a costly work. The part already issued is a quarto volume of 291 pages with forty-nine plates, ten maps and eighty-five cuts. Of the plates seven are of the moths, one being coloured and the others done by the heliotype process, thirty which are coloured illustrate the larvæ with great fulness of detail, ten are devoted to venation, one to other structural details, and one to three moths with the larvæ of two of them.

The eggs and cocoons or pupæ are not illustrated on the plates, but a number of pupæ are illustrated in the introductory part of the work.

For the Geometridæ the monumental "Monograph" of Dr. Packard, published by the United States Government as one of the volumes of its geological survey of the territories, should be in the hands of every lepidopterist who can afford the very moderate price, $4 I believe, at which it is, I suppose, still obtainable.

This magnificent work is in quarto form, consists of 607 pages and 13 beautifully engraved plates, six being devoted to venation, one to anatomical details, and the remaining six to the perfect insects and a few larvæ and pupæ. These six plates contain no less than 389 figures of moths, and thirty-six figures of larvæ and pupæ. The work embraced all species of this group known to Dr. Packard up to the date of its publication, and is indeed wonderfully complete.

For the Pyralidæ I know of no exhaustive work, but for the Phycitidæ the paper by the Rev. Geo. D. Hulst in the Trans. Am. Ent. Soc. XVII., 1890, and obtainable separately, I believe, for about one dollar, should be studied. This paper consists of 136 pages and three plates illustrative of structure and venation.

For the Orambidæ, Prof. Fernald's recent monograph of eighty pages, with its three plates of venation and structural details, and its six exquisite colored plates of the species is all that could be desired, but for the Tortricidæ there is no reasonably complete work at a moderate price One of the earliest illustrated papers was that by the late Coleman T. Robinson, published in Trans. Am. Ent. Soc. II., 1869, which was intended to be the first of a series to include the whole of the species found in the U. S. This first paper illustrated with six beautifully colored plates, embraced descriptions of no less than seventy species, but the project was cut short by the untimely death of Mr. Robinson. Since that event the chief work issued on that group is that of Lord Walsingham, eighty-four pages, quarto, with seventeen colored plates, published by the trustees of the British Museum, but this is a somewhat expensive work, costing £2.

I do not know of any general work on the Tineina.

In regard to catalogues and check lists, there is no general catalogue of North American Lepidoptera. For a mere check list I would recommend that issued by Prof. J. B. Smith, with the assistance of Drs. Skinner, Hulst, Fernald and Riley, which is sold at $1.00.

For the butterflies Edwards's "Revised Catalogue of Diurnal Lepidoptera," issued in 1884 is to be recommended, though Dr. Strecker's catalogue, issued in 1878 at the cost of $2.00, though having certain defects, contains much useful information and more complete references.

For the Sphingidæ, Zygænidæ and Bombycidæ, using the latter term in its older sense, there is no American catalogue, but they are, of course, embraced in Kirby's world-wide catalogue of Sphinges and Bombyces, with the exception of some of the groups, such as the Ægeriadæ, which he excludes, but this is an expensive work costing £2 4s

For the Noctuidæ we are indebted to Prof. J. B. Smith for a comprehensive catalogue of 424 pages, which is obtainable for $2.50.

Other works might be mentioned with commendation but the selection has been purposely restricted to those which are most indispensable.

Of books on the other orders of insects I am not competent to speak, but for any-one who is primarily interested in the economic relations of butterflies or other insects no works can be more highly recommended than "Insects Injurious to Fruits," by Dr. Wm. Saunders, and Prof. J. B. Smith's "Economic Entomology."

It is, doubtless, impossible to do much in the entomological line without some books, but by a judicious selection ten or twenty dollars may be laid out to purchase a very fair selection of the most useful works for a beginner, and then other works could be added as one's interest in the subject developed and one's means would admit.

SOME HOUSEHOLD INSECTS.

By Rev. C. J. S. Bethune, Port Hope.

So many enquiries are repeatedly made respecting common insects that frequent houses and cause annoyance to the inmates, or damage to household goods and provisions, that it has seemed desirable to give some account of those most frequently complained of, and suggest some methods of dealing with them. Hitherto very little has been published upon this class of troublesome insects, and not much has been known about their life histories; but last year the deficiency was satisfactorily removed by the publication at Washington of a bulletin on "The Principal Household Insects of the United States," by Dr. Howard, Entomologist in Chief of the Department of Agriculture, and his assistants, Messrs. Marlatt and Chittenden. In the following pages we shall freely draw upon this work, as nowhere else can the same accurate information be obtained, and by no other writers have the life histories of these insects been so carefully studied and the details so clearly and admirably set forth.

COCKROACHES.

Most houses in towns and cities are infested with cockroaches to a greater or less extent, and even isolated dwellings in the country are sometimes inhabited by an unwelcome colony of these creatures. I have known them to be introduced into remote places by means of the trunks of visitors, or packages of groceries received from some distant city. Mr. Fyles (15th Annual Report, 1884, p. 43) relates the occurrence of large numbers at Chaudiere Curve, a wayside station, nine miles from Point Levi, P. Q., where luggage is transferred from the Grand Trunk to the Intercolonial Railway, and *vice versa*, and where the insects were evidently brought by immigrants from Europe. They usually frequent kitchens and pantries and are especially abundant about the stove or fireplace on account of their fondness for heat. For this reason, as well as for the sake of the abundant food supply, they are often present in great numbers and become a perfect nuisance in bakeries. They are also excessively numerous and troublesome on board ship, the moisture and heat of the vessels being particularly favorable to them. In the daytime they are rarely seen, as they always avoid the light, and conceal themselves in crevices, behind baseboards, under boxes or barrels, etc., wherever in fact they can squeeze their flat, thin bodies, and escape observation. If disturbed they scuttle off with great rapidity to the nearest hiding-place and can rarely be captured or destroyed. It sometimes happens that a large colony has established itself in a kitchen for months without being discovered, till a sudden entry with a light after the usual hours has revealed their presence.

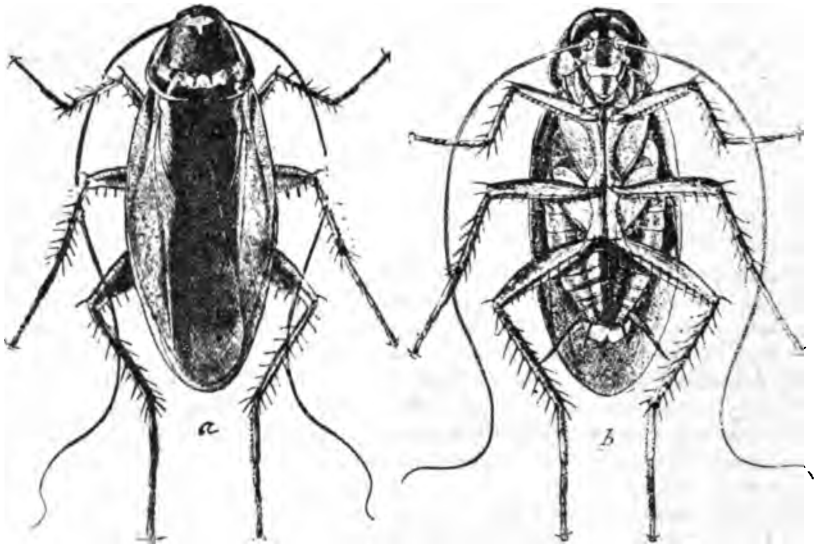

Fig. 32. The American Cockroach; *a* view from above; *b* from beneath; both enlarged one-third (after Marlatt).

Cockroaches belong to the family Blattidæ, of the order Orthoptera, which includes crickets, grasshoppers, locusts, etc. This family consists of a very large number of species, nearly a thousand having been named and preserved in collections, and it is estimated that about four times as many more are in existence in the world, chiefly in tropical countries. The great majority of them live out of doors and are vegetable feeders, and some attain to large dimensions. I have a specimen from Mexico, whose wings expand five inches, and larger species than this are known. Happily, but few species have become domesticated, and in North America there are only four that can be regarded as household pests. These are the American Cockroach (*Periplaneta Americana*), the German (*Ectobia Germanica*), the Oriental (*P. orientalis*), and the Australian (*P. Australasiæ*). As far as my limited experience goes, the first named, the American Cockroach (Fig. 32) is the common species in Ontario. Full grown specimens are about an inch in length, of a light brown color, and furnished with ample wings in both sexes. It is a native of this continent, having originated in the warm regions of the south and gradually spread northward ; it is especially abundant in the Middle and Western States, its place being taken in the Atlantic States by one or other of the imported species.

The German Cockroach (Fig. 33) is more familiarly known under the name of the "Croton Bug," from its association with the Croton waterworks system in the city of New York. It had, no doubt, been introduced into the city long before, but had not attracted general attention till the extension of the waterworks and the immense multiplication of piping in houses enabled it to make its way from one building to another without difficulty, and the dampness and heat of hot water pipes afforded it the most favorable conditions for living and increasing. As its name indicates, it is a European species, being particularly abundant in Germany and the adjacent countries. It has, however, been carried by commerce and emigrants to all parts of the world, and is now spreading so rapidly in England, owing probably to the immense importation of goods "made in Germany," that Miss Ormerod tells us it is supplanting the familiar English species, known as "the black beetle." It is much smaller than the other domestic species, rarely exceeding five-eighths of an inch in length, very light brown in color and distinctively marked on the thorax with two dark brown stripes. It is more active and wary than the larger species and much more difficult to get rid of; it also multiplies much more rapidly, the breeding period being shorter and a greater number of eggs being produced at a time.

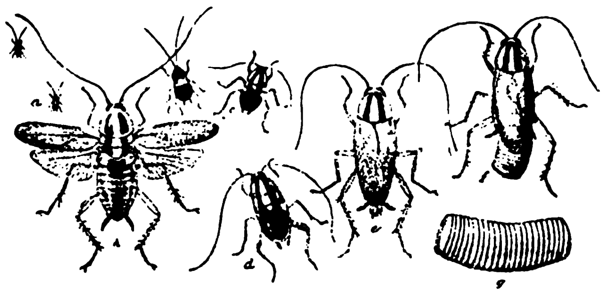

Fig 33. The German Cockroach ; *a* first stage ; *b*, *c*, *d*, second, third and fourth stages ; *e* adult ; *f* female with egg-case ; *g* egg-case enlarged ; *h* adult with wings spread. All natural size, except *g*. (After Riley).

The Oriental cockroach is the common species in England, where it is known in the household by the name of "the black beetle." It is supposed to be of Asiatic origin, and to have spread through Europe several centuries ago. It is very dark brown, almost black, in colour, shining, and much stouter than the other species. The wings of the male are shorter than the body and in the female are so abbreviated as to render her practically wingless. It is notably gregarious in habit, the individuals living together in colonies in the most friendly manner. This species was brought in early days to the British settlements in North America and is very common now in the Eastern States ; it has also spread far inland, and has been found even in New Mexico

The fourth species, the Australian, resembles very closely the American cockroach, but may readily be distinguished from it by the bright yellow band surrounding the prothorax and the yellow dash from the shoulder on the sides of the upper wings. It is very abundant in Florida and some of the southern states, but is not likely to become acclimatized in Canada. A specimen was sent to me last summer by a lady in Toronto who had found it among some bananas. It is the only living specimen that I have seen in this country, and evidently came with the fruit from the tropics.

The structure and life history of the domestic cockroaches are thus described by Mr. Marlatt: "They are uniformly dark brown or dark coloured, a coloration which corresponds with their habit of concealment during daylight. They are smooth and slippery insects, and in shape broad and flattened. The head is inflexed under the body, so that the mouth parts are directed backwards and the eyes directed downward, conforming with their grovelling habits. The antennæ are very long and slender, often having upwards of 100 joints. The males usually have two pairs of wings, the outer somewhat coriaceous and the inner ones more membraneous, and once folded longitudinally. In some species the females are nearly wingless. The legs are long and powerful, and armed with numerous small bristles or spines. The mouth parts are well developed, and with strong biting jaws, enabling them to eat all sorts of substances.

"The cockroach in its different stages from egg to adult shows comparatively little variation in appearance or habits. The young are very much like the adult, except in point of size and in lacking wings. In their mode of oviposition they present a very anomalous and peculiar habit. The eggs, instead of being deposited separately as with most other insects, are brought together within the abdomen of the mother into a hard, horny pod or capsule which often nearly fills the body of the parent. This capsule contains a considerable number of eggs, the number varying in the different species, arranged in two rows. When fully formed and charged with eggs the capsule is often partly extruded from the female abdomen and retained in this position sometimes for weeks or until the young larvæ are ready to emerge. The capsule is oval, elongate, or somewhat bean shaped, and one of its edges is usually serrate. The young are in some instances assisted to escape by the parent, who with her feet aids in splitting the capsule on the serrate side to facilitate their exit. On hatching, it is said, the young are often kept together by the parent and brooded over and cared for, and at least a colony of young will usually be found associated with one or two other individuals.

"They pass through a variable number of moults, sometimes as many as seven, the skin splitting along the back and the insects coming out white, soft, but rapidly hardening and assuming the normal colour. Their development is slow, and probably under the most favourable conditions rarely is more than one generation per year produced. The rate of growth depends largely upon food and temperature, and under unfavorable conditions the time required for development may undoubtedly be vastly lengthened. The abundance of cockroaches is, therefore, apparently not accounted for so much by their rapidity of multiplication as by their unusual ability to preserve themselves from ordinary means of destruction and by the scarcity of natural enemies."

They will eat almost anything, animal or vegetable, and especially the food materials found in store rooms and kitchens. They will also gnaw boots and shoes, the cloth and leather binding of books, which they sometimes damage very seriously, the paste or sizing used being apparently the chief attraction. In a house that I occupied a few years ago they were very numerous in the kitchen and scullery, and often made their way up to my study on the floor above. One night when I was writing, a specimen climbed up on my inkstand and began to drink the ink. After watching it for some time I killed it, and found the body was completely filled with ink! Evidently nothing comes amiss to them in the way of food.

But besides the loss they occasion by their consumption of supplies, they are almost a greater nuisance from the disgusting odour they leave on everything that they touch, and which cannot be got rid of without vigorous washing with soap and hot water.

Dishes of food left uncovered at night are often utterly ruined in this way by the morning, and their contents have simply to be thrown away.

Remedies.—A clean kitchen, with well-scoured sink and no damp places or neglected dark corners, will usually be fairly, if not entirely, free from these creatures, as the conditions are not favorable to their multiplication. But if they should become established, it is necessary to wage an active warfare against them. First we should recommend a thorough "house cleaning" of the kitchen, pantries and parts adjacent, moving everything under which they could possibly squeeze their flat bodies, and killing all that can be found; then apply powdered borax to all cracks and crevices in the floors, skirting boards, wainscots or walls. This will usually be found effective, and the cockroaches will disappear; but if not fully exterminated at once the powdered borax should be applied again after a short interval. It is, happily, a clean substance, and its use is attended with no unpleasantness.

Another remedy that is highly recommended is the use of Pyrethrum insect powder. This must be fresh and applied liberally to all places frequented by the insects. It is, however, much more expensive than borax, and involves more trouble, as the cockroaches are usually only partially paralyzed by it, and require to be searched for in the morning and destroyed in the fire. If the infested portion of a building can be made air-tight, the insect powder may be burnt and the fumes will penetrate into every crevice and destroy the creatures in their hiding-places; but this plan can rarely be carried out effectively. Instead of burning insect powder, bisulphide of carbon might be evaporated with still more deadly effect; but this is too dangerous a remedy to be employed in a dwelling house.

A simple mode of trapping them has been found very useful. Any deep vessel or jar may be used. Place against it a number of sticks bent over so as to project a very little way into the interior; half fill the vessel with stale beer, for which the insects have a special fondness. In the morning great quantities of dead and dying specimens will be found, which have climbed up the sticks and dropped into the liquid within. By frequent use of a trap of this kind the number of cockroaches on the premises may be very satisfactorily reduced.

HOUSE ANTS.

Next to the cockroaches, the insects mostly complained of by housekeepers for their depredations upon the domestic stores are what may be called the "House Ants," as distinguished from those that live out of doors and rarely come into dwellings. The species about which I receive the most enquiries, and which has been very troublesome in my own house in the summer time, is the little reddish-yellow ant (Fig. 34) (*Monomorium pharaonis*, Linn). Another species, about equally common and troublesome is the little black ant (*M. minutum*, Mayr.) The former makes its nest in the house itself as a rule, finding a suitable place under the flooring or in the wall behind the plaster; it sometimes selects for its abode a place near a hot water pipe and in such cases con-

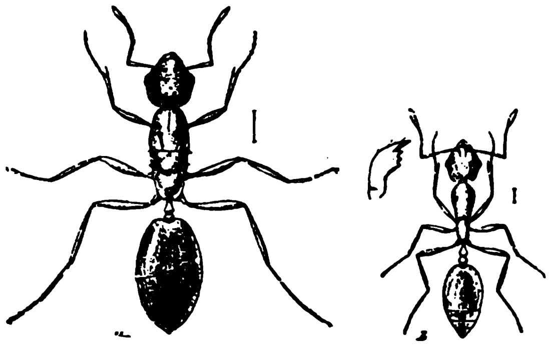

Fig. 34.—The red ant (Monomorium pharaonis): *a*, female; *b*, worker—much enlarged. (After Riley.)

tinues its activity throughout the winter. The black species has its nest out of doors and finds its way in through the crevices of a window frame or some other tiny opening. Both species are annoying, not so much from the amount that they make away with, as from their habit of getting into articles of food, especially sweets of any kind. Frequently the sugar bowl, when brought to table, is found to be swarming with them, or the pot of jam or marmalade that was opened for one meal is full of smothered specimens as well as lively ones when brought out of the cupboard for the next.

It is unnecessary here to enter into any description of the marvellous life-history and habits of ants. Many most interesting books have been written upon their highly organized societies and their remarkable intelligence, among these may be mentioned the works of Dr. McCook and Sir John Lubbock. We are only concerned now to know enough about these tiny species to enable us to deal with them effectively. The individuals that cause the annoyance are all neuters, or workers; the males and females do not appear upon the scene. Should the nest be discovered, there will be found within it one or more females, and a quantity of larvæ and pupæ, which from their white colour and shape are popularly supposed to be eggs. At a certain season of the year, which varies with different species, there may be seen issuing from the nest, apparently in a tremendous state of excitement, a swarm of winged ants, which speedily take flight and from their numbers in the air frequently prove a great nuisance to those whose persons may be covered with them. These winged individuals are males and females, whose marriage takes place in the air. The males soon perish and the females which escape their natural enemies, birds, toads, etc, remove their wings and begin the work of forming new colonies, producing an immense quantity of eggs.

It is evident that the destruction of the workers that come into the house will not exterminate the colony to which they belong. It is therefore all important, if possible, to discover the nest. This may often be done by following the line of advancing and retiring workers till they are traced back to their abode. If at all practicable, without injury to the house, the nest should be destroyed by pouring into it some coal oil or boiling water; where this cannot be done, it may be possible to inject a small quantity of bi-sulphide of carbon, but care must be taken not to have any light near for fear of an explosion, and to air the apartment thoroughly afterwards. In the case of the little black ant, it is often much more difficult to find the nest in consequence of its being out of doors, but when found its destruction is usually an easy matter as it may simply be drenched with coal oil. Failing the discovery of the nest, the only effective mode of getting rid of the nuisance is to entrap and destroy the ants as fast as they appear. This can readily be done by taking a wet sponge from which the water has been squeezed and sifting fine sugar into it; lay it on a plate or saucer where the ants are in the habit of congregating, and in half an hour or so it will be found full of ants; drop it with its living contents into boiling water and get rid of one host of invaders; repeat the operation from time to time and in a few days the ants will cease to be troublesome. They will, however, appear upon the scene again after some time, when the same process will have to be repeated; but it requires but little time and the expenditure of no large amount of patience.

While housekeepers complain of these tiny ants, gardeners often make enquiries regarding the destruction of the much larger species which disfigure lawns by the great mounds they construct over their nests. A very easy and expeditious method is to be found in the use of bi-sulphide of carbon. Last summer I completely exterminated three colonies on my lawn in the following manner: I purchased a two ounce vial of the bi-sulphide, and at dusk in the evening, when the ants had returned home from their foraging expeditions, I poured about a third of it down the principal openings into the nest and at once covered the whole with a sheet of brown paper. After about ten minutes I set fire to the paper, which caused a series of explosions to take place within the nest. The next morning not a single ant was to be seen, and the mound was easily flattened down. The scorched grass soon recovered, and in a week or two not a trace of the unsightly nest remained. The other two nests were destroyed during the same evening and in a similar manner.

MOSQUITOES.

No insect causes so much annoyance and actual suffering to the human race as the Mosquito. It is everywhere prevalent in the summer time and in many localities is so excessively abundant as to be an intolerable pest. Though only active in warm weather it seems that no amount of cold will destroy it. It occurs in prodigious numbers in our Northwest Territories, and, if the travellers' tales from the Yukon and Klondike may be credited, it swarms within the Arctic Circle in such myriads that human beings can hardly live under its overwhelming and incessant attacks.

Though so common an insect and so obtrusive in its onslaughts upon entomologists as well as upon ordinary mortals, it is a remarkable fact that almost nothing was known about the American species till they were recently studied by Dr. L. O. Howard, of Washington, and the results of his observations were published in the volume mentioned at the beginning of this paper. Writers have been content to quote the descriptions given by Réaumur of a European species, which he studied at Paris one hundred and fifty years ago, and have taken for granted that his careful and accurate records made in France are applicable, without verification, to the numerous species that inhabit North America. That the species are numerous, notwithstanding the general practice of speaking of "the Mosquito" as if there were but one kind from the Atlantic to the Pacific, is shown by the fact that Mr. Coquillett has determined twenty distinct species in the collection of the National Museum at Washington, and there is good reason to believe that not half the existing species are represented there.

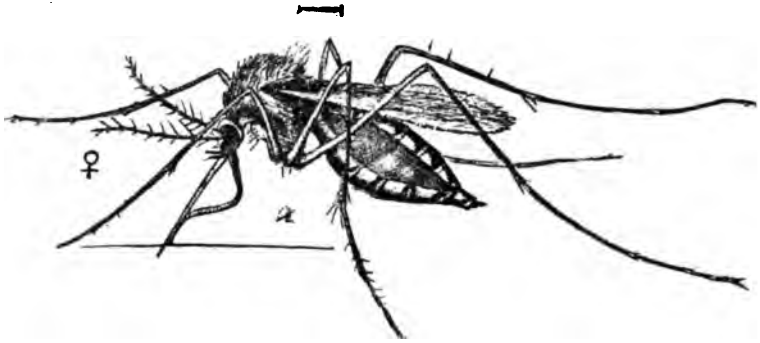

Fig. 35.—Female mosquito (*Culex pungens*), side view—much enlarged. (After Howard.)

Dr. Howard has made *Culex pungens* (Fig. 35) a species common at Washington, the subject of his special studies, and we may present here a condensed account of his history of its life as being typical of any species with which we may be troubled. The eggs are laid on the surface of water in masses containing from 200 to 400. As seen from above, the egg-mass is gray brown; from below silvery white, the latter appearance being due to the air film. The eggs laid during the night began to hatch at two o'clock in the afternoon of the same day during warm weather towards the end of May, but in cooler weather they sometimes remained unhatched until the second day.

The larvæ (Fig. 36) issue from the under side of the egg masses and are extremely active at birth. In general they pass through apparently three different stages, reach maturity and transform to pupæ in a minimum of seven days When nearly full-grown their movements were more carefully studied as they were more easily observed than when newly hatched. At this time the larva remains near the surface of the water, head downwards, with its respiratory siphon, which takes its origin from the eighth abdominal segment at the exact surface and its mouth filaments in constant vibration, directing food into the mouth cavity. Occasionally the larva descends to the bottom but never remains below the surface for more than a minute at a time. In ascending it comes up with an effort, with a series of jerks and wrigglings with its tail, but descends without difficulty, its specific gravity seeming to be greater than that of water.

The pupa (Fig. 36) differs from the larva in the great swelling of the thoracic segments, and in this stage the insect is lighter than water. It remains motionless at the surface and when disturbed does not sink without effort, as does the larva, but is only able to descend by a violent muscular action. It wriggles and swims as actively as the larva, and soon reaches the bottom of the vessel or breeding-place. As soon as it ceases to exert itself, it floats gradually up to the surface of the water again. The air tubes no longer open at the anal end of the body, but through two trumpet-shaped appendages on the thorax, from which it results that the pupa remains upright at the surface, instead of with the head downward. This reversal of position enables the adult insect, which issues from the thorax, to support itself on the floating skin while the wings are expanding.

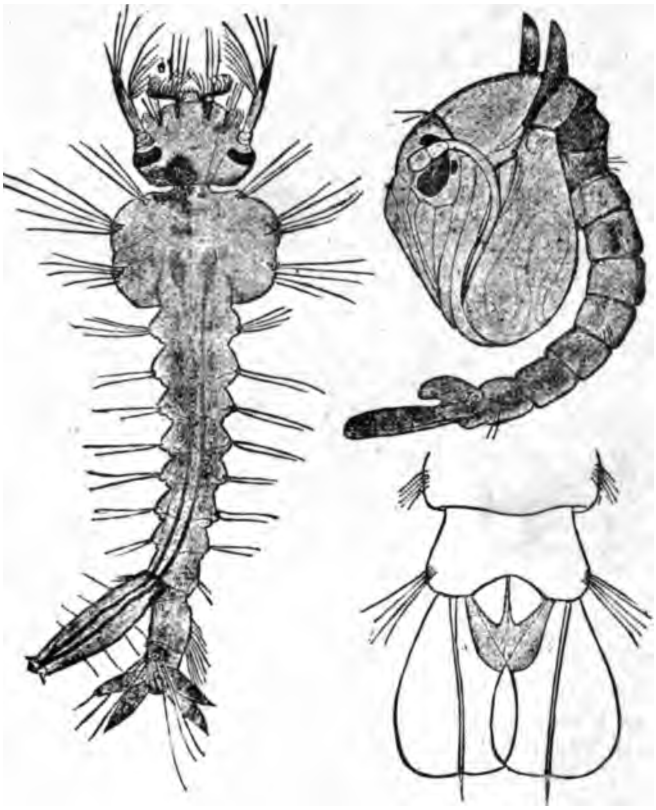

Fig. 36.—Full grown mosquito larva (*Culex pungens*) at left; pupa at right above, its anal segment below—all greatly enlarged. (After Howard).

The shortest time observed for the life of the insect from the laying of the egg to the emergence of the winged mosquito was ten days, during hot weather at the end of June; but the length of time which is required for a generation may be indefinitely prolonged if the weather should be cool. The extreme shortness of this June generation is significant, as it accounts for the fact that swarms of mosquitoes may develop upon occasion in surface pools of rain water, which may dry up entirely in the course of two weeks, or in a chance bucket of water left undisturbed for that length of time.

The insect passes the winter in the adult winged state and frequently resorts to cellars and out-houses for the purpose. The degree of cold seems to make no difference to their successful hibernation, as may be understood from their abundance in the extreme north.

It is a well known fact that the adult male mosquito does not necessarily take any nourishment, and that the female cannot depend upon the blood of warm-blooded animals for its food. Mosquitoes undoubtedly feed normally on the juices of plants, and not one in a million ever gets an opportunity to taste blood. When we think of the enormous tracts of marsh land into which warm-blooded animals never penetrate, and in which mosquitoes breed in countless numbers, the truth of this statement becomes apparent.*

Remedies.—To prevent the annoyance of mosquitoes in houses, particularly in bed-rooms, it is a good plan to burn a small quantity of pyrethrum powder, about enough to cover a fifty cent piece, heaped up in the shape of a cone and lighted at the top; this will suffice for an ordinary sized bed-room. The fumes penetrate to all parts of the room and stupify the insects for some time. Should they revive, the operation may be repeated. Of course the door and windows should be closed for the time being in order to prevent the escape of the smoke from the burning powder. A quiet night may also be secured by killing all the mosquitoes that are to be found resting on the walls and ceiling of the room. The latter may be reached by tacking the lid of a small tin box to the top of a sufficiently long stick and putting into it a spoonful of coal oil. If this cup is shoved under a mosquito on the ceiling it will at once try to escape, and in its efforts fall into the coal oil and end its existence.

A far more important matter, however, is the destruction of the larvæ, or the abolition of their breeding-places. In our Annual Reports for 1892 and 1893, papers by Dr. Howard were published in which he gave most interesting details of his experiments with coal oil for the destruction of mosquito larvæ. It need, therefore, only be mentioned here that the method consists in pouring a thin layer of coal oil over the surface of the water in which the insects are breeding. The larvæ and pupæ, we have seen, live almost entirely at the surface of water and cannot remain beneath for more than a minute at a time. The coal oil will at once fill up their breathing tubes and cause immediate death. Large numbers also of the female mosquito will be destroyed before their eggs are laid, as it has been found that the coal oil does not deter them from trying to deposit their eggs on the surface of the water. This method, of course, can only be employed in the case of pools of stagnant water of no very large dimensions. When the breeding-place of the mosquitoes is too extensive to admit of this treatment, their numbers can be kept in check by the introduction of small fish into the waters. But the most fruitful places for the production of these pests on a large scale are swamps and marshes. Nothing but their drainage, which may prove a profitable undertaking for other purposes, will suffice for a cure. Rain water barrels and similar receptacles, which are common about houses in the country, produce swarms of mosquitoes during the summer and these readily find their way into the rooms so close at hand. All such vessels for holding water should be kept closely covered, especially at night, when the female mosquitoes resort to them for the purpose of laying their eggs.

FLEAS AND BUGS.

The consideration of the blood-thirsty mosquito leads one on to think of other insects that have similar evil propensities and that sometimes become a torment to suffering humanity. Fleas are now rarely met with in the older settled parts of Canada, though they were common enough thirty years ago; occasionally, however, a house may be found to be infested with them. Dr. Howard states that the species most frequently sent to the Department at Washington from cities in the Eastern States proved to be the cosmopolitan flea of the dog and cat (*Pulex serraticeps*), and not, as was supposed, the human species (*P. irritans*). This accounts for the rarity of these pests in well-ordered houses where the dogs and cats are kept clean.

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*For many interesting particulars regarding mosquitoes, see a paper by Mr. J. A. Moffat in the 24th Annual Report, 1893, page 43.

Fleas (Fig. 37) belong to the order Siphonaptera, a name derived from the sucking apparatus of the mouth and the absence of wings in the adult insect. The body is oval and greatly compressed, allowing the insect to move freely between the hairs of the animal upon which it lives; it is also very hard and smooth, enabling the creature to slip away from between the fingers of its captor or the teeth of a dog. Its escape is also facilitated by its long and powerful legs, which enable it to leap an immense distance when compared with the size of its small body. Its eggs are laid between the hairs of the infested animal, but are not fastened to them, so that when the animal moves about or lies down they are shaken off to the floor or ground. The larva, which is very minute and rarely seen, except by those who search for it for purposes of study, lives upon the animal and vegetable matter contained in the dust to be found in the cracks of floors or the sleeping-places of animals. The frequent sweeping and scrubbing of the rooms in well-ordered households is, no doubt, an effectual preventive of their development.

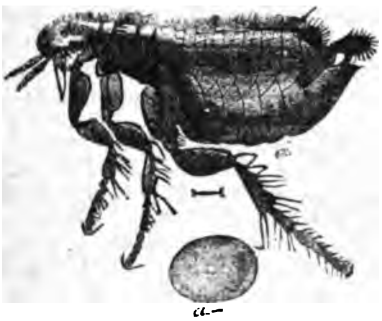

Fig. 37.—Adult flea (*Pulex serraticeps*): *a*, egg, both much enlarged. (After Howard).

Remedies.—Should a dog or cat be found to be infested with fleas it should be thoroughly dusted with insect powder, and its sleeping place turned out and cleaned. Any bedding it has lain upon should be burnt and fresh material such as straw or shavings, be supplied and frequently renewed. The kennel should also be washed inside with some coal oil or benzine. If any rooms in a house are infested, the carpets or rugs should be taken up and thoroughly beaten and shaken out of doors and the floors scrubbed with hot soap and water. An ingenious plan for exterminating the lively adults was adopted by a Professor in one of the buildings of Cornell University. He tied sheets of sticky fly-paper, with the sticky side out, around the legs of the janitor of the building and kept him walking for some hours up and down the floor of the infested room. Nearly, if not all, the fleas jumped on his ankles, as their invariable habit is, and were caught by the fly paper!

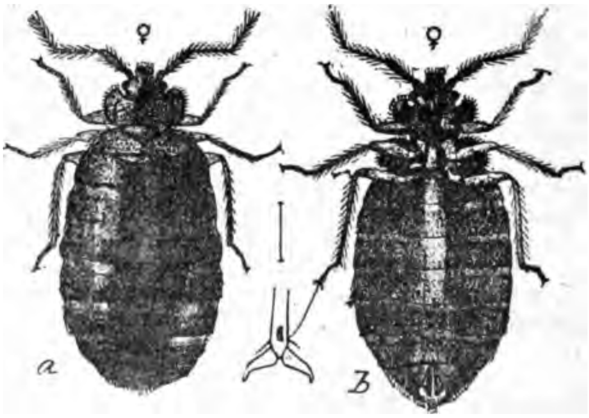

Fig. 38.—*a* Female bed-bug (*Cimex lectularius*) gorged with blood; *b* same, from below—much enlarged (after Marlatt).

The Bed-bug (Fig. 38) is, unhappily, a well-known pest all the world over, and though usually confined to houses of the meaner sort where cleanliness is not regarded as a virtue, it frequently finds its way into well-ordered households, to the great dismay and horror of the inmates. It belongs to the order Hemiptera, which includes the true bugs, a race of insects provided with a piercing and sucking beak, and usually furnished when fully grown with two pairs of wings, the first pair of which are thickened at the base like the wing-covers of beetles, but only covering about half the back, the remainder being thin and membranous. The bed-bug, however, is destitute of wings, otherwise it would probably be a far more common pest than it is ; in colour it is reddish brown ; the body is round or oval in shape and very flat, so that it can easily crawl into cracks or crevices in furniture, walls or floors. The writer has on several occasions been compelled to deal with these disgusting creatures, when occupying for the first time some premises that had been previously inhabited by dirty, careless people. Once it was a cottage containing four or five rooms that was intended as a dwelling for a laundress and her family. It was found to be swarming with bugs. The windows, doors, etc., were stopped up and made as air-tight as possible, and then powdered sulphur was set on fire in an iron vessel in each room and left till the following day. This was repeated two or three times ; the house was then thoroughly scrubbed and the walls freshly papered. It was a great satisfaction to find that the method adopted was perfectly successful and not a single bug was afterwards seen. In the case of furniture, especially wooden bedsteads, the best plan is to apply benzine or coal oil to all joints and crevices which may harbour the insect, and repeat the operation till there is no doubt of its extermination. The benzine may be forced into the crevices by means of a fine syringe, or with a small paint brush. The liberal use of hot soapsuds to all woodwork is also of very great value.

Among other household insects one of the worst pests is the Clothes Moth, a full account of which was given by Dr. Fletcher in our Twenty-third Annual Report, 1892, page 53 ; it is unnecessary therefore to deal with it here. The Cheese or Meat Skipper, a serious trouble at times in the larder, has also been recently discussed by Miss Mary E. Murtfeldt in the Twenty-fourth Annual Report, 1893, page 98.

Library pests are not a serious trouble in Canada so far as I am aware, but in more southern and damper climates they are often very destructive. It was highly gratifying to learn a few months ago that the annual reports of the Entomological Society of Ontario had been the means of saving the public library at Hamilton, Bermuda, from a threatened destruction. During the winters of 1892 and 1893 I had the pleasure of spending a few weeks in those delightful isles, and on each occasion was kindly welcomed by Mr. F. T. Frith, the librarian. He was much distressed by the abundance of a "book worm" which was doing much damage to the bindings and the inside of the backs of many of the volumes in his charge. The insect was evidently a species of *Lepisma*, commonly called "the silver fish," from its peculiar form and scaly body. At the time I recommended the use of insect powder as a possible preventive, though it could not be very conveniently used without the risk of soiling the books to some extent. As a result of my visits our annual reports have been regularly sent to the Bermuda library, and Mr. Frith now tells me that he has carried out with complete success a method of destroying the insect that he learnt from these pages. In the Twenty-fourth Report, 1893, page 94, there is an article on "Fumigation with bisulphide of carbon for the complete and rapid destruction of the insects which attack herbarium specimens, furs, woollens, etc." and a description is given of a fumigating chest for the purpose. Mr. Frith adopted the plan and had several wooden chests made, lined with zinc, carefully soldered at all joints. Around the upper edge of the box a gutter of zinc was made and filled with water, into this falls a flange of metal from the lid and thus the box is perfectly sealed and no air or vapour can pass through. In these boxes he placed as many books as they would hold and on the top of them an open vessel of bisulphide of carbon. The liquid soon evaporates and the vapour, being heavier that atmospheric air, gradually penetrates to the bottom. The books were left in the chests for a day or two, and then they were replaced by others, until the whole of the library was gone over. The operation has proved thoroughly successful and now no obnoxious "book-worms" are to be seen, whereas formerly scarcely a volume could be opened without finding one of these creatures. Thus has the Entomological Society of Ontario saved from destruction the public library of Bermuda !

ON THE ENTOMOLOGICAL RESULTS OF THE EXPLORATION OF THE BRITISH WEST INDIA ISLANDS BY THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY L. O. HOWARD, PH. D.

The extremely interesting and important work which is being done under the auspices of the British Association for the Advancement of Science, in the way of an exploration of the fauna and flora of certain of the West India Islands, has attracted a great deal of attention in this country. The comparatively large sums of money at the disposal of the British Association enable it to carry on many lines of investigation of greater or less importance. To working zoologists, however, the Association has never done anything of greater importance than the present investigation.

In 1887 the first appropriation of £100 was made by the Association. In 1888 the committee in charge of the work co-operated with the sub-committee of the Government grant committee of the Royal Society, and an additional appropriation of £250 was made. That year, as a preliminary step, a bibliography of the published writings on the fauna and flora of these islands was published in the Report of the British Association. In 1889 Mr. F. du Cane Godman, who has done so much good by his survey of the fauna and flora of Central America, co-operated with these committees by sending Mr. Herbert H. Smith, the well known American collector, at his own expense, to St. Vincent. The Association this year made a further grant of £180. In 1890 Mr. Smith had already collected and sent in 3,000 insects from St. Vincent, and the announcement was made that Mr. Godman had continued his employment and sent him to Grenada. At the close of the year 1891 investigations had been made in Dominica, St. Lucia, Barbadoes, St. Vincent, the Granadines, and Grenada. In 1892 the reports upon the insect material began to be published. Practically the material in hand in entomology consists of Mr. Smith's collections, covering a period of two years or more in the islands of St. Vincent and Grenada. These islands are respectively the next to the northern-most and the southern-most of the group known as the Windward Islands—St. Vincent lying directly south of St. Lucia, and Grenada forming the bottom of the chain of the lesser Antilles, bounding the Caribbean sea. Grenada lies only about seventy-five miles from Trinidad, and Trinidad, as is well known, possesses practically a South America peninsula fauna. The careful survey of the results of the collections upon these islands, therefore, should reveal many interesting facts regarding the distribution of species, the most important of which will be the determination of the continuation of the Central American fauna, which holds, as we know, in the main, for the larger West India Islands, running from Yucatan and Honduras through Cuba, Jamaica and San Domingo. Does this fauna persist down through the lesser Antilles, or do we have in these extreme islands a fauna more similar to that of the closely adjacent coast of South America, or is there a coast fauna common to these islands and the entire coast line of South and Central America ?

In these investigations the British committee has shown an energy and catholicity of spirit very much to be admired, and which is quite in common, it seems to me, with the general trend of British scientific work. The smallness of their own home island and the thoroughness with which the insects are known has driven British entomologists to all quarters of the globe in search of new material. The British systematists in entomology to-day are concerning themselves with collections from all sorts of out-of-the way places. Wherever the British traveler goes (and the British are famous travelers), a collection of insects is apt to result, and there is usually in England some worker who is ready to undertake the description of the new forms. This is particularly the case with the larger and better known orders, Lepidoptera and Coleoptera. Outside of these groups the committee has found it desirable to ask the assistance of foreigners, both on the continent of Europe and in America. The material has been thus distributed in the hands of many entomologists and the work of describing and classifying goes merrily on. Already, although as previously stated, it was only in 1887 that the investigation was first begun, papers have been published by Lord Walsingham on the Microlepidoptera;

by Simon on the spiders; by Bruner von Wattenwayl on the Orthoptera; by Uhler on the Hemiptera; by Forel on the ants; by Matthews on the Trichopterygidæ and Corylophidæ; by Peckham on the Attid spiders; by Kirby on the dragon-flies; by Gahan on the Longicorns; by Champion on the heteromerous Coleoptera; by Williston on the Diptera; by Waterhouse on the Buprestidæ, and by Ashmead and Howard on the parasitic Hymenoptera. There are papers in preparation by Blandford on the Scolytidæ; by Butler and Hampson on the Heterocera; by Champion on the Elateridæ; by Gahan on the Phytophaga and Lamellicornia; by Kerremans on the Buprestidæ.

I have been much interested in examining all of the papers which have been so fa published on the insect collections I have seen them all, except Dr. Williston's "Dipter of St. Vincent," which, although just published, has not yet reached me, and a paper by Warren, on "New Genera and Species of Geometridae," in which, I learn from the Zoological Record of 1894, no less than 170 new genera have been proposed. The remaining papers cover a rather large field, including groups of Coleoptera, Lepidoptera, Hymenoptera, Heteroptera, Hemiptera, and Arachnida, although in no one group have the entire results appeared.

A brief summary shows that exclusive of the two papers just mentioned, 1472 species have received consideration up to the present time. Of these 789 are new to science while 683 have previously been described. These 1472 species are distributed in 836 genera, of which 75 are new. What a notable contribution to science we have, even at the present time!

In attempting to summarize the conclusions of the different authors in regard to the character of the fauna considerable difficulty is experienced. In many of the groups descriptive work is not enough advanced to allow accurate generalizations and in others certain of the workers have seemed indifferent to the broad interest attaching to this side of the investigation. In Mr. Champion's work upon the Heteromera it is stated that all of the genera except four are common to Central America, and all except eight have been found in South America. Ten are common to Central America, but he states, in general, that taken as a whole, the material studied by him shows a considerable affinity with the fauna of the northeastern parts of South America. The number of endemic genera are very few and the endemic species closely allied to the South America forms. As a result of Uhler's studies of the St. Vincent species he shows that the collection of Homoptera "is an assemblage of forms, mostly small and neat, which offer a striking contrast to the large and showy insects that inhabit the regions of the South American continent, a few hundreds of miles away. It is not, however, to this nearest part of the continent that we must look for the source of distribution from which this assemblage was derived. The Mexican character of the fauna seems unquestionable." In his consideration of the Heteroptera of Grenada he says that "the hemipterous fauna is Central American. It is largely composed of forms which belong to the borders of the tropics, rather than of such distinct tropical ones as inhabit the South American continent." Lord Walsingham, in his consideration of the micro-Lepidoptera, says that the forms are decidedly American, ranging northward to the southern and western portions of the United States and southward as far at least as Brazil; "the majority, however, certainly belong to the truly Central American fauna." In this sentence however, Lord Walsingham speaks of the West Indies as a whole, when, as a matter of fact, of the forty-six species which he describes from St. Vincent, thirty-eight were new while two had previously been found in Brazil, four in the United States, one in Venezuela and two were cosmopolitan. Of the species studied by Mr. Simon from St. Vincent, about eighty per cent. are new, although a considerable number of the novelties were known by him from his own collecting to occur in Venezuela. Of the old species all had previously been found in northern South America, Central America, or southern United States. Only two, in fact, range into the United States. Mr. Gahan simply indicates "a pretty close relation between the West Indian fauna and that of tropical America." Dr. Williston writes concerning the Diptera that most of the forms were minute and consequently belong to groups that have been but little studied from South to Central America. The relationships he considers to be decidedly South American.

Of the parasitic Hymenoptera described by Mr. Ashmead and myself the condition is much like that mentioned by Dr. Williston. The study of the South and Central American forms is not sufficiently advanced to enable any definite conclusions. Mr. Ashmead is of the opinion that the general character of the collections in the families which he has worked up is Central American, but it is only fair to say that the only South American collections which can be compared are those made in the interior of Brazil by Mr. H. H. Smith.

And this introduces what is probably the pith of the whole question of distribution. We must have full collections from the coast of North and South America, as well as full collections from the interior, with elevations carefully noted, before we can speak authoritatively. It has been suggested that the coast fauna of the entire Caribbean Sea is practically the same and that the tableland further to the interior is also practically the same. That many Central American forms extend through the chain of West India islands is undoubted, but whether the entire character of the fauna from one end of these islands to the other is Central American, yet remains to be proved. The opinions which I have quoted show the uncertainty which yet exists, but it is to be hoped that with the publication of the other papers, and the consideration of the entire results, there may be some satisfactory outcome.

It is gratifying to observe that American systematists are receiving deserved recognition at the hands of the British Committee. No less than eight American entomologists have been or are engaged upon the collections. It is a pity, however, that investigations of this character, so pregnant in possibility of valuable results, cannot be undertaken under American auspices. Our lack of thorough knowledge of the faunas and floras of the many interesting regions within our own domain is apparent to all workers. Our own Association is too poor to make successive grants of the magnitude of those made by the British Association, but the subject is one which should be agitated by all of us. Explorations are being made by the general government and by educational institutions, but in general, although the plants and the larger animals receive a fair degree of attention, the minute creatures, and particularly the insects, are, in the main, neglected.

PROTECTIVE RESEMBLANCES.

By J. Alston Moffat, London, Ontario.

That the harmonizing of living beings to their surroundings in nature is protective in its influence, does not admit of a doubt, and those who have had the greatest opportunity for observing life in its native conditions are those who are most impressed with the fact. Tropical countries are those where examples of it are most numerous, and probably more striking than in temperate and more northerly regions, for one good reason at least, that life there is more abundant and diversified; and in insect life especially is this the case. Writers upon the subject draw their most surprising examples of it as a rule from southern sources, yet many instructive illustrations of the same principle can be found in our own country. Everyone that has engaged in the health producing and delightful recreation of collecting and observing the habits of insects during a ramble over mountain and meadow, through wood and marshes, or along a lake shore, can give of his own experience instances of how completely his senses were imposed upon by appearances. A familiar example is the Geometrid larvæ that resemble closely the branch of the tree on which they rest, some of them standing out at an angle from the branch like a bit of broken twig, that requires close observation to make sure that it is not what it appears to be. Or Catocala moths, that are so much like the bark of the tree upon which they are at rest that even a trained eye does not always detect them. When collecting them in the day time I have switched a tree, started one and watched it alight upon another, then got within four feet of it and many a time failed to discover it, although I knew it must be right before my eyes, and had to start it again before I could get another sight of it. So closely at times does the animate resemble the inanimate.

Loitering in a bit of open wood on a hot day, with the mind more active than the body, my eye was arrested by the unusual appearance of a particular spot upon a moss-covered tree. My mental reflection was: How much that bit of moss has assumed the appearance of a moth. I looked closely. It seemed to be a bit of moss only; I gave it a punch with the end of my cane when a desirable specimen of *Agrotis prasina* fell to the ground, ruined.

Having made the discovery that many of the fall moths rested during the day in the shrivelled leaves remaining attached to the trees and bushes, and that a sharp stroke with a stick would bring them to the ground as if dead, I struck an oak branch, something dropped. I recognized nothing but bits of tinted leaves on the ground, and was on the point of moving on when it occurred to me that it fell too heavily for a bit of leaf, then I looked intently, stooped down and examined closely, when I detected the form of a moth, and such a beauty as I thought I had never seen before; my first specimen of *Xanthia togata*, arrayed in golden yellow and purplish brown, blending into and harmonizing perfectly with the tints of the decaying vegetation around it.

The first *Cryptolechia Schlægeri* that I came upon, with its pure white patches and dark and light gray mottling, resting conspicuously on the upper surface of a dark green leaf, and its wings so tightly rolled around its abdomen that the thorax and head formed a lump at the one end, whilst it tapered off to a sharp point slightly turned up at the other, I found it utterly impossible in the "dim religious light" prevailing under the leafy dome of a virgin forest, to decide whether it was the dropping of a small bird or an insect. So to settle the question I jarred it into my open umbrella when it rolled down the side without showing the slightest signs of life and I had concluded to dump it on the ground, but when it reached the level it gave a hitch to regain its feet, and it was dumped into my collecting bottle. *C. Schlægeri* was always a rather scarce moth with me; one and two in a season was usually the limit of my captures, and sometimes a season would pass without my seeing one. Upon one occasion I thought myself in great luck; I had not been long at one of my hunting grounds when I espied the now well known object in its usual attitude on the surface of a leaf. I secured it and very soon I got another; whilst looking around I detected at a little distance the indication of a third. I thought to myself, they are plentiful to-day, so moving towards it I was in the act of enclosing it, when my opinion changed. Oh! That's it, is it? Ah, well, it can stay there; it was the reality this time, not the resemblance.

Strolling in a beech wood one sultry day, and feeling oppressed with excessive heat and want of success I sat down upon a fallen tree. Whilst contemplating the surroundings my attention was arrested by what appeared to be some dried beech leaves attached to a fallen branch that was lying about four feet in front of me and about eight inches from the ground. They were of the same bleached-brown color as the leaves that covered the ground everywhere around. They were partially erect, and seemed to be but loosely attached to the dead branch, as they trembled with every passing zephyr, and they had a decidedly ragged appearance. I could not see anything that held them to the branch, there was no spider web visible, yet they remained suspended. I looked and I wondered, and the more I looked the more I wondered, until at last curiosity overcame my disinclination to exertion, I rose and examined, when I found that I had got a perfect specimen of *Cressonia juglandis*. The deceptive appearance was so complete that it had never entered my mind to suspect it to be a living creature of any kind.

These are a few examples illustrative of how resemblance can be protective to the lives of insects against the raids of collectors, but there is a condition that has to be associated with it to render it perfectly effective, and that is complete motionlessness. Let any insect resemble the substance upon which it is resting ever so closely but move, it has exposed its individuality and its doom is sealed. Life is associated in the human mind with motion. In this case the parallel between man and the lower animals is exact. A large proportion of the carnivora prefer to secure their food in a living state, and for that purpose wait to see it move before seizing it. Travellers inform us that lions and tigers of the jungle will not spring upon a motionless object, and that safety in an emergency may be secured by feigning death. There are families of birds that take their food only on the wing. A fly is perfectly safe within three inches of a toad's nose if it remains still, but let' it attempt to secure safety by flight and it instantly ceases to be an independent portion of animate nature. This gives some indication of how important a matter it is for the safety of insect life that they should remain perfectly still.

But there is another important question that has to be taken into consideration in this connection, and that is the condition of the eyesight, and there is a wide diversity in the zoological world in this matter, from that of the most perfectly developed, to where it is a point in dispute if they have any at all. Yet the ordinary vision of every portion of it is nicely adjusted to its needs. That man's eyesight is not all that he would like is made abundantly plain by his invention of the telescope and microscope, and his constant effort to improve and extend their powers, and that the vision of many of the lower animals does not even reach his is undoubted. The question has often been discussed whether insects have any consciousness of form and color. I am quite certain that a humming bird does not know a man from a post if he remains perfectly still. I have had a Pewee come in contact with the hand that was holding a bottle against a tree in its eagerness to secure a Catocala fluttering within, seemingly wholly unconscious of my presence. Many a time when resting in the woods has a ground squirrel come out of its hole close by me. It seemed to realize at the first glance that there was something unusual there, but whether there was danger in it or not it could only discover by investigation, so with that object in view it would come cautiously toward me and would approach so close that I have thought it would climb upon me if I could have kept perfectly still, but my breathing would excite its suspicion. We have the testimony of sportsmen that it is movement that excites alarm in game and makes it seek safety in flight, not the form of the hunter. Hence the utter worthlessness for the purpose intended of those hideous objects we see erected in fresh sown grain fields, and called "scarecrows." They lack motion, or it is of a rythmical order, and observation soon leads to the conviction that there is no danger in their presence, then familiarity breeds contempt. So then motion is regarded as a sign of life throughout the whole animal world, whether it be in the securing of proper food on the one hand, or as a warning to escape from the feeders on the other, and motionlessness is one of the best means of defence against those that are seeking life to take it, and in the insect world it plays a most important part.

But if insects have very defective eyesight as judged by our standard, they have a complete advantage over us in the faculty of scent. Their power of locating their mates is well known and phenomenal. One example more. Being in an open wood on an early November morning with a light fall of snow on the ground, I saw two moths about forty feet in front of me and about thirty feet apart flying towards each other. I hastened forward to see what they were. They passed out of sight behind a tree about four feet from me; I stepped round it, one of them flew away, the other was secured by the wingless female of an Anisopteryx. And it is quite reasonable to suppose that this faculty is of advantage to them in other respects, such as in securing their food and in deciding upon the correct location for ovipositing. There are certain ichneumons that confine their attention exclusively to some particular kind of larvæ. If they have no power to distinguish between the form and color of the various kinds of caterpillars, then it must be by scent that they are guided in their choice, whilst movement on the part of the larvæ would enable them more readily to locate the object of their search.

There is now the question of how much can be learned from observation and experience. We know how much man is indebted to it for his knowledge and wisdom. Practice will enable one person to detect an object where one without it would see nothing; it also sharpens the faculties to distinguish between things that differ, and to the very last he is gaining knowledge by means of it. Many of the lower animals can be educated to some extent in a similar manner, and many of them have been brought to exhibit a wonderful degree of intelligence in that particular direction to which they are naturally inclined, and there can be little doubt but many of them in a state of nature acquire considerable knowledge in their life time, how best to conduct their affairs in the condition in which they find themselves placed. The ground squirrel gave unmistakable evidence of being possessed of memory, which is the foundation on which education is built, hence it is capable of being instructed up to the limits of its faculties. How far short-lived insects that come into the world thoroughly under the control of a few desires which they devote their whole time and energies to the gratification of, and whose faculties at the moment of their birth are complete for all the requirements of their existence, do, or can acquire further knowledge by experience for the better ordering of their lives, is a good deal of a problem yet to be solved. I am aware that there is a doctrine of "cumulative mental inheritance," but into that I do not enter. A peripatetic professor gave a lecture upon the "occult sciences." At least, said a reporter, that is what he was advertised to lecture upon, but it is doubtful if there was one in the audience that knew what he was talking about. But then, added the reporter, it is doubtful if the lecturer had the slightest advantage over the audience in that respect.

NOTES ON THE SEASON OF 1897.

By J. Alston Moffat, London, Ont.

The weather here during the past summer was of a decidedly unusual character The spring opened finely, but May and June were uniformly cool with frequent rains, vegetation progressed steadily but very slowly. July maintained its character for heat, a succession of excessively hot days in it, with heavy showers throughout the month. August was uniformly cool with less rain, and some light frosts at its close; whilst the first part of September was warm, it closed with killing frosts, and the month was excessively dry throughout. Such conditions had a marked effect on insect life, retarding and confusing the appearance of many species, whilst it would no doubt be the means of destroying numbers of them. The ordinary cut-worm moths were present to some extent, but none of them were reported here as being noticeably destructive. The army-worm seems to have retired again to its usual obscurity; but there were plenty of the moths about the lights late in the season, to keep the breed alive, and be ready to produce a future outbreak when the conditions are specially favorable. The frequent rains seemed to have a disastrous effect upon the web-worms, as at no time during the season were their offensive-looking tents at all conspicuous. During the early part of September I noticed the clover-leaf weevil, *Phytonomus punctatus*, Fab, in considerable numbers on the streets of London, indicating that someone's clover had been suffering in this neighborhood. Whilst on a visit to Essex, I saw in the collection of Mr. E. N. Laing a Tobacco sphinx, *Protoparce carolina*, Linn, which he had reared from the caterpillar, and as tobacco is now being grown quite commonly in that region as a regular commercial crop, this species may yet become abundant. In a school collection made not far from London, under the superintendance of the teacher, Mr. J. W. Atkinson, and exhibited at the Western Fair, I saw a specimen each of *Megalostoma* (*Colias*) *cæsonia*, Stall (Fig. 39), and *Terias lisa*, B.L. What a splendid thing it would be for our country if every school teacher was an interested collector in some department of natural history, as his example would give a respectable standing to the habit of observing and taking an interest in those simple objects of nature that are strewn so profusely around us, with all the educational, elevating and refining influences associated with it, and which is such an inexpensive means of securing untold enjoyment to those who engage in it. Natural history is now being taught in our schools; to what profit is not apparent. It is set as a task which

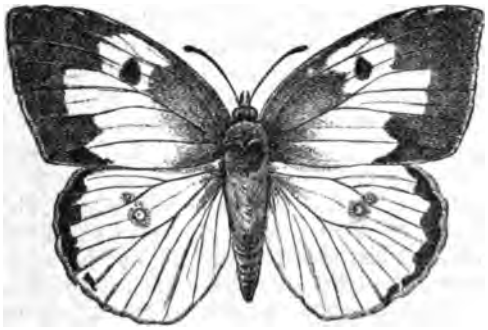

Fig. 39.

has to be learned to pass an examination, and when this is accomplished it is thrown aside as having served its purpose. It may be true, and very likely is, that "Naturalists" like "Poets" are born, not made; yet I have known parents to prohibit their children indulging a strong inclination to collect natural history specimens, which they greatly admired and in which they took much pleasure, for fear that it might interfere with their school lessons. And by the time they had left school they had lost all taste for natural history. A young lady whose father is known in his locality as an artist and a geologist, and whose brother stands very high in financial circles, but has also gained for himself a name in geology, told me that she was once at a bazaar when her uncle, her mother's brother, said he would pay for anything she liked to take from a particular table. She choose an odd-looking shell in the rough. He scouted the idea, and wanted her to decide upon something that he thought was of some value. But no; she wanted nothing but that shell; and she wanted it very badly. Then handling and looking admiringly upon her treasure she thoughtfully remarked: "We inherited that propensity." From your father's side, I remarked. Oh! she exclaimed, laughingly, there is nothing of that sort whatever on our mother's side. I knew a woman whose boy was given to collecting natural history specimens, and would take them to his mother and would speak of their beauties or peculiarities, and she would look and listen with apparent interest, but she confessed to me that she could see nothing of what he was talking about in them. She did not let him know. She knew they were to him a great source of innocent enjoyment, the treasures which his heart instinctively turned to, and which drew him to his home, and made it exceedingly pleasant for him to stay there; and she was pleased. Wise woman, if unfortunately defective in her perceptive faculties. A personal collection is what is wanted to give interest and permanence to the study of natural history. Whilst others derive benefit from looking at it, it may help to induce them to begin one also.

Elaborate discourses have been given upon "How to study Natural History." Some of them well calculated to crush out all aspirations in that direction, as they land you at once in a tangle of unintelligible phraseology. We have, I dare say, all heard the directions for, how to cook a hare: "First, catch the hare." To any one who has a desire to obtain some knowledge of the natural sciences in any of its numerous branches I would say, first collect your specimens. That is, such as are conveniently obtainable, which excludes astronomy and seismology. Then examine your specimens, when you will probably learn something about them that you did not know before. This may induce you to look at them again, to discover yet something more. Taste can be cultivated, and the faculty of observation is sharpened by exercise. Then you will likely want to collect more, as your curiosity may have become excited; curiosity leads to inquiry. Enquiry when judiciously exercised leads to knowledge. Knowledge when obtained is gratifying, and in time the pursuit of it becomes a perfect pleasure. And the more you know the easier and pleasanter it becomes to acquire more. Then keep that up, a little now and a little again, and very soon you will find it such a delight that, no matter what your condition or occupation may be, you will find some time and opportunity to indulge in it. And if you are endowed with capacity, endurance and perseverance you may attain to the very highest position in your department; but do not expect to begin there; it is not the rule at school to begin with mathematics and work down to the alphabet.

A professor of natural history in a prominent educational institution wished to obtain transparent wings of insects, such as the Neuroptera or gauze-wings, to make lantern-slides of to throw enlarged upon a screen. These I was much pleased to provide him with, and interesting and beautiful objects some of them made. He also wanted the sting of a bee. It was winter. I said I could give him dried specimens, but he might find it difficult to secure a perfect one from such; but from a fresh specimen it could be easily obtained. How? he inquired. Just squeeze the abdomen and it could be cut off perfect, root and all. And where is it situated, in the mouth? Oh, no, I replied, at the other end. But a mosquito's is, is it not? That man knew a good deal about many things, but he must have commenced to learn about where the people usually leave off. We find many men who seem to have forgotten that they ever were boys; but one would be almost ready to believe that the professor had never been a boy.

My own work during the season has principally been, delightedly observing the results of Mr. Bice's collecting at electric light. I have thought it would be an excellent method of determining the time of appearance of different species; and if they were single or double brooded. I was somewhat surprised to see *Scoliopteryx libatrix* appear in the spring, as I had always regarded it as a strictly fall moth. The specimens were too fresh, and rather late in the season to have hybernated. *Homaphila noctuella* I have often wondered about. It appeared about the first thing in spring, in a sadly worn and dilapidated condition; clearly indicating that it had been sporting in the grass during the warm days of the previous autumn, and continued without intermission to the end of the season. Mr. Felt, *Can. Ent.*, vol. 25, p. 131, says: "There seem to be three broods a year." But I suspect that the broods must overlap, as they were never wholly absent. In mid-summer they were unusually plentiful, with an endless variety of ornamentation; from a uniform light-brown with numerous dark brown dots, to a yellowish-brown with three heavy dark brown transverse bands on their long narrow front wings.

In the September number of the "Entomologists' Record" is a note on "The Attractiveness of Light," signed W. Grover, Guildford, dated July 9th, 1897, in which, after relating that he had found some colored lights more attractive than ordinary light, enquires "Why is light attractive to the males only of so many species?" This was an idea new to me, although we had been having some experience on that very line without suspecting the cause. In the early part of September, the males of *Tolype velleda* (Fig. 40) were in great abundance, and those of *laricis* in goodly numbers. Mr. Bice had a pair of *velleda* of last year's take, but he wanted females of *laricis*. He knew that the female *laricis* was light like *velleda*, but smaller, and he wanted me to give him the distinguishing marks of female *laricis* when at rest, as he was tired taking male *velledas* in a futile attempt to get the female of the other. This I found it very difficult to do; I could separate them by the antennae and the form of the abdomen, but to give a recognizable discription of the front wings to separate the two, I did not at the time seem capable of doing. So I requested him to get me a lot to see what I could make out of them. He then brought me a bottle full, so I began pinning, spreading and drawing out their antennae, which they keep completely out of sight under their shoulder pads. After filling two setting boards and finding only male *velleda*, I began to get tired. So I pinned the male *laricis*, then turned up to view all the rest, when I noticed two differing from the others in the whiteness of the upper surface and deeper scollops in the dark outer band, so I pinned and spread them and found they had bristled antennae and rounded abdomens, which confirmed my expectations that they were female *laricis*. Being under the impression that the females would appear later, I took Mr. Bice a specimen and pointed out to him how he might recognize female *laricis* when at rest, but he saw no more of them. I also requested him to get me a lot of female *velleda* to go with the males I had spread; he secured one, and could get me no more, when they totally disappeared shortly after. The rule in this case was not absolute, but it seems to point in the same direction as Mr. Grover's experience; and it is well to be warned in such matters what one has to expect, but the query remains, why is it so? It is known that female insects as a rule are less active than males; and in this case it would be quite excusable for such a portly, richly-robed dame, to refuse to join the revelers by night and dance around a light-pole; yet some of them did, but it may be placed to the credit of the sex that they were not the noblest of their kind.

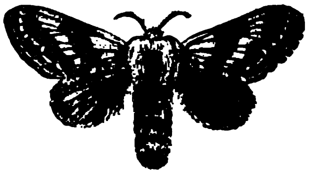

Fig. 40.

Mr. Bice has again secured quite a number of fine moths new to the Society's collection. Those that I have thus far been able to identify are a single specimen of *Thyatira pudens*, Guen. This seems to be a very rare insect in this country. The large spots on the front wings are a silvery white with the faintest tinge of pink. In Guenee's colored figure, plate 3, fig. 1, they are altogether pink. A single specimen of that large and handsome geometer *Selenia kentaria*, G. & R., and perhaps the first reported from Canada. It is much deeper in the reddish-brown of the underside than is represented in Mr. Grote's colored illustration, fig 5, plate 1, vol. 1, Trans. Amer. Ent. Soc. Phila. A single specimen of *Aplodes rubromarginaria*, Pack. Also one of *Plagodes Kentzingaria*, Pack. One of *Gortyna speciosissima*, G. & R., a particularly attractive species, illustrated on plate 7, fig. 52, vol. 1 Trans. Am. Ent. Soc., Phila Also a sphinx new to Canada, *Dilophonota obscura*, Fab. Dr. J. B. Smith directed me to his description in the "Transactions of the American Entomological Society, vol. 15, page 157, where it is clearly defined. He gives the habitat as, "Pa.(?) Texas, Mexico, West Indies, South America." Then adds, "Easily recognized by the small size, gray primaries and unbanded abdomen. Specimens of this very rarely range northward, and a specimen in my possession was said to have been taken in Pennsylvania. I do not know the source whence I obtained it and I cannot vouch for the locality. It is a southern form." All these were most generously surrendered by Mr. Bice to the Society, and form a valuable addition to its collection. He also took several specimens of that curious little snout moth, *Gaberasa ambiqualis* of Walker, the *Tortricodes bifidalis* of Grote. It has a split in the front wings of the males, fringed like an incipient feather wing. The first one I saw puzzled me greatly, not knowing but it might be only a freak of nature, instead of a characteristic of the species. An appeal to Dr. Smith put me straight, when he also informed me that the wings of the female were entire Both sexes were taken by Mr. Bice. Mr. Grote at first described the females as a separate species, whilst at the same time strongly suspecting that they were but the different sexes of one species. There are a number of Mr. Bice's captures yet to be determined.

NOTES ON THE SEASON OF 1897.

By Rev. Thomas W. Fyles, F.L.S., South Quebec.

The "Notes on the Seasons," published in the Annual Reports of the Entomological Society, of Ontario, will, I think, be found useful to the rising entomologists of our own day, and, in the future will afford material that may be worked into a complete history of the insects of Canada. In this belief I contribute to the store my memoranda on things that have come under my observation during the past summer.

The season was a remarkable one ; the early summer was cold and wet, then came a period of intense heat, which was succeeded by a bright, mild autumn prolonged into November.

Brephos Infans, Moeschler.

On the 24th of April members of the Montreal Branch invited me to join them for an excursion in search of *Brephos infans*, Moesch. We went to a birch wood some distance from Montreal, and soon had the pleasure of seing *infans* on the wing. It flies amid the tops of the birches, making an occasional descent to lower foliage. These descents are the entomologist's opportunities ; but, as the insect has a rapid and uncertain flight, they can be captured only by a lucky stroke, or a well sustained effort.

I left the business of catching to my companions, for, as we advance in years, we lose—to use the words of Alexander Smith—

> "——the wild-deer from the blood,
> The falcon from the eye."

I sat on a stone and watched my friends dash through puddles formed by melting snow and amidst the scrub on the outskirts of the wood, admiring their zeal.

The expedition was a successful one, and, from a female captured on the occasion, Mr. Dwight Brainerd obtained eggs, from which both he and I succeeded in bringing larvæ to the pupal stage. His notes regarding them will be found in the November number of the *Canadian Entomologist.*

The larvæ I reared were about a week later in their changes than those raised by Mr. Brainerd. This was owing, no doubt, to the difference of climate between Quebec and Montreal. At Quebec the eggs hatched on May the 8th. The larvæ moulted on May the 13th, May the 21st, and June the 2nd, and pupated June the 20th. This species spends probably eight months in the pupa.

CTENUCHA VIRGINICA, CHARP.

On the expedition above referred to I obtained larvæ of *Ctenucha Virginica*, Charp. which had just aroused themselves from their winter's sleep, and were feeding on the wild grasses in the wood. This is a description of them at the time:

Head reddish brown, sides and back set with pencils of black hairs, a sub-dorsal row of tufts of whitish hairs springing from a white line, spiracular line white; moulted April the 26th.

After Moult, head chestnut red with black face. A frill of white hairs round the head. Distinct black tufts along the back, sub-dorsal lines pale yellow with yellowish tufts, white spiracular line with tufts of whitish hairs, legs red; moulted May the 21st.

Full Grown Larva, one inch in length, head chestnut-red with black face, mouth organs white, a dorsal line of black tufts bordered on either side with a line of yellow tufts, sub-dorsal line yellow, spiracular line white, between them a line of black tufts, under parts black, legs red.

One larva was almost white—the tufts on its back were yellowish.

Of three that I took particular notice of:—

The 1st spun up May the 28th, and the moth appeared June 25th.
The 2nd " June 9th " " July 7th.
The 3rd (the pale one) spun up June 30th, and moth apeared July 18th.

Newly caught females of *C. Virginica* laid eggs which hatched on July 25th. The larval stage of this species therefore extends over a period of ten months or more.

THE CASE-BEARER OF THE BIRCH.

In the beginning of May, as soon as the leaves of the birch were fairly opened there appeared upon them the curious habitations of a species of Coleophora. The following is a description of the larvæ producing them:—

Head brown with a pale V-like mark—opening towards the front—and a few white bristles, shield on second segment brown divided by a pale line, small shield on third segment and anal plate brown, claspers brown, general body color brownish-salmon, darker on the back; length on the 24th of May, two-tenths of an inch.

The larval case at first appears as a closely-woven, elongated capsule with little brown tufts in it. The occupant, when it finds this habitation too narrow, selects at the edge of a leaf a portion bordered with two or three serrations. This it hollows out by eating away the parenchyma. Then it works its way in, cuts off the selected portion, and proceeds to unite the free edges, thus making a new tent. It fills up all awkward interstices with a fine web. Under the microscope the veins and stomata of the skeletonized section of leaf thus appropriated present a beautiful sight.

In feeding the larva bites a round hole in the cuticle of the leaf on one side, and then eats away the parenchyma as far as it can reach on every side without leaving its case entirely.

The larvæ ceased feeding in June, and the moth appeared on July 9th. This is a description of it:—

Colour, pale silvery ash, a tinge of reddish-brown on the after part of the primaries, secondaries narrow, ciliate on both sides, eyes black, antennae beautifully ringed—brown and white, fringes slightly tawny, tibiæ of hindmost pair of legs clothed with long hairs, expanse of wings half an inch, length of antennae three-twentieths of an inch. Length of body, one-fifth of an inch.

Spilosoma Congrua, Walker.

I took a female of this species at the Gomin on the 29th of June. It laid eggs on the 10th of July, and these hatched six days afterwards. The larvæ fed on pig-weed, dandelion and plantain. I succeeded in bringing the whole batch to the pupal stage, and took full notes of all their changes. As soon as the appearance of the moths enables me to complete the life history of the species I will send the particulars to the *Canadian Entomologist* for publication. I may say that the larvæ are very different in all their stages from those of *H. textor*, and seem to indicate that *Congrua* should come in the genus *Arctia*.

Unfortunate Selandria Larvæ.

On the 7th of July I found on a young ash at St. David's a number of milk-white larvæ with black, shining heads, and black feet (*S. varda*, Say ?) They were about three-fourths of an inch long. Next day they moulted, and, after the moult, seemed smaller than before. Their colour was changed to pale lead-colour above and a pale yellow beneath. The head was dark brown above, the face yellow. The legs also were yellow. They fed no more, but became inert and dropped to the ground. The cause of all this became apparent when, on the 23rd of the month, there came from them a number of Tachina flies.

Captures in August.

On the 6th of August, passing through the Fort Woods at Levis, I found a bush of *Spiræa salicifolia* Linn. in full bloom. It was thronged with insects. Without moving from my position I captured *Sannina exitiosa*, Say (Fig. 41), *Conops sagittaria*, Say, *Anthrax fulviana*, Say, *Perilampus ceruleus*, Say, *Philanthus bilunatus*, Cress, *Eumenes fraterna*, Say, *Gorites phaleratus*, Say, *Exetastes rufo femoratus*, Prov., etc., etc.—a great haul! Moths of *Gelechia gallæ-diplopappi*, Fyles, appeared from the 8th to the 15th. *Catocala parta*, Guen. (Fig. 42) was very abundant at the end of the month.

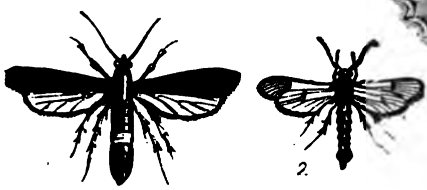

Fig. 41. Female moth on left, male on right.

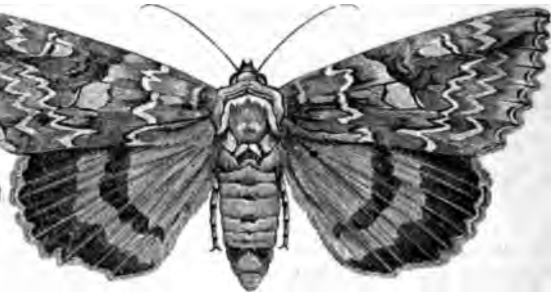

Fig. 42.

Blisters on Poplar Leaves.

On the 9th of August I found blisters on poplar leaves. Each blister was about half an inch across. It contained a larva which changed to a chrysalis before I could describe it. The chrysalis was attenuated and about three-twentieths of an inch in length. On the 28th of the month it produced a lovely little moth. In length of body this was only one-eighth of an inch. Its wings expanded three-twentieths of an inch. The fore-wings were golden brown, and had a set of creamy white patches bordered inwardly with black, and running transversely from either side to the middle of the wing. The hind wings were narrow but deeply fringed. The palpi were white and feathery, the eyes black, the legs were white and had feathered tibiæ. This I concluded was the *Lithocolletis populiella* of Chambers.

MORE SAW FLY LARVÆ.

On the 9th of August, the light shining on a leaf of *Populus tremuloides*, revealed to me a number of cuts, each about one line in length, on the under side of the leaf. I knew them to be vacated saw-fly cuts, and immediately looked for the young larvæ. On several leaves near by a number of round holes were seen, and looking closely into these I found in every one a black larva extended along the edge inside the opening. When disturbed the larvæ threw up their tails in true Nematus fashion. They grew rapidly, and in the night of August the 14th they threw off their dusky covering, and presented themselves in a splendid new garb of dark navy-blue with black dots, and with large yellow spots in a line with the black spiracles. The head was glossy black. The legs and underside were of a neutral tint. The length of the full-grown larvæ was seven-tenths of an inch.

On August the 20th the larvæ descended and spun loose brown cocoons under the leaves in the bottom of their cage. I obtained from these, on the 8th of September, some very handsome saw-flies, of which the following is a description :—

Length of body, three-tenths of an inch; expanse of wings, seven-tenths; length of antennae, two tenths.

Head black, but with clypeus, hypoclypeal plate, labrum and palpi yellow. Clypeus emarginate rather short. Eyes round and prominent, black. Ocelli black. Cheeks rounded and protruding. Antennae with a somewhat moniliform scape; the second, third and fourth joints rather long and nearly of equal length, the other four smaller and slightly tapering; the whole one coloured—black.

Tegulæ and pronotum flavescent; lateral lobes of scutum dark chestnut-red; the rest of the thorax and the base of the abdomen black. The abdomen, for the most part, is of a clear, chestnut-red without dorsal markings, but the cerci and ovipositor are black and the last joint is clouded.

The first and second pairs of legs are flavescent throughout. The hind pair have the tibia—except the knee, which is yellow—and the tarsus black. The tibiæ are thickened, and the tarsi end with extended claws.

The wings are beautifully clear, and in some lights iridescent. Their venation is remarkably distinct, and is of the normal type.*

SAW-FLY LARVÆ ON CORNUS.

In the beginning of September there were handsome larvæ in great numbers feeding upon *Cornus stolonifera* Mich. and *C. alternifolia* Linn. When they first came under my notice they were curled, helix-like, under the leaves, lying in clusters. The head was glossy black, the body pale yellow; but down the back were eleven rectangular patches resembling buckles, blue black with yellow centres. There was also a terminal patch, rounded, and of the same colour. The creatures had just changed their skins. They moulted again on the 14th of September. The empty skin was held by the claspers and stood upright. The head-case and second segment were split, and the rest of the skin was intact. The larvæ after the moult were more highly coloured than before. The rectangular markings on the back were deep navy-blue, and the inner mark and dividing lines were pale blue. The yellow of the rest of the body was of a deeper shade. They moulted again on the 30th of the month, and at intervals in October they retired into the earth. I found specimens on the Cornus bushes after the frosts came.

CAPTURES IN SEPTEMBER.

On the 1st I took *Plusia brassicæ*, Riley (Fig. 45. *a*, caterpillar; *b*, cocoon; *c*, moth), and *Petrophora testata*, Linn, at the Gomin. On the 3rd I found *Feltia venerabilis*, Walker; *Agrotis redimicola*, Morris; *Plussia brassicæ*, Riley, and *Drasteria erechtea*, Cramer (Fig. 44), on panicles of *Solidago nemoralis*, Ait., in the open fields. On the 11th

Orgyia nova, Fitch, was flying in the sunshine at the Fort Woods, and *Cleora semiclusaria*, Walker ; *Plagodes fervidaria*, H. & S.; *Petrophora truncata*, Hbn. (second brood), *and P. diversilineata*, Hbn. (Fig. 45), were plentiful on the boles of spruce trees. On the 22nd *Epirrhita dilutata*, Bork, was out at the Fort Woods. On the 24th *Callocampa curvimacula*, Morris, was abundant at sugar, and *C. parta* was still out but much worn.

Captures in October.

October the 15th was very mild. The thermometer stood at 64° on my verandah at 8 p.m. *Xylina georgii*, Grt., was abundant at sugar. On the 20th of the month a fine, fresh specimen of *Pyrameis Atalanta*, Linn, was taken on the streets of Levis. On the 23rd the wind was in the south, and the day bright and balmy. *Teras ferrugana*, Schif, was plentiful among the sallows, and *P. fervidaria* was still out. On this day I found the full-grown, denisciform larvæ of *Syrphus ribesii*, Fab, feeding upon *Schizoneura lanigera*, Hausm. They spend the winter in the larval stage, and go into pupa early in the spring. The flies appear in April.

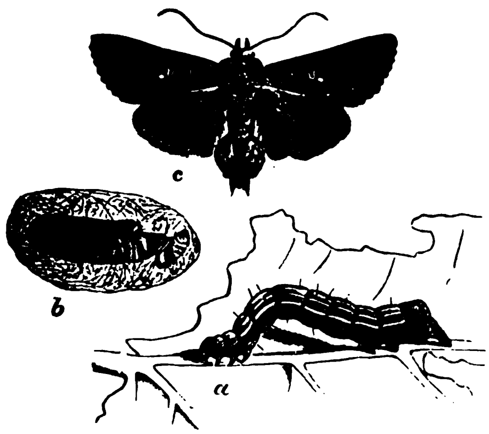

Fig. 43.

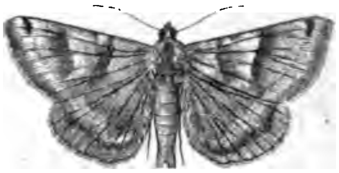

Fig. 44.

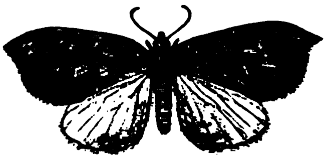

Fig. 45.

And now the winter storms are come, and we must be content—like schoolboys in their contemplation of the holidays—to think for half the dreary time of entomological pleasures past, and to anticipate in the other half pleasures to come, cheered in the meanwhile by the monthly visits of the *Canadian Entomologist*. May no unkind blizzard detain the mails that convey it !

A FEW NOTES ON THE SEASON OF 1897.

By Arthur Gibson, Toronto.

The season of 1897 in the neighborhood of Toronto was, entomologically speaking, a comparatively poor one, as far as "good things" were concerned. Indeed, most of the commoner lepidopterous insects, especially the butterflies, were rather scarce, and those which are usually scarce were in most cases not to be seen at all.

The season of 1896 was a very good one in this district, several species of lepidoptera having been observed and taken for the first time in this locality.

During the past season the only diurnals which I know of as having been taken in this neighborhood, and which are really worth mentioning are :

Feniseca Tarquinius.—One specimen observed at Forks of Credit on 1st July.

Lycaena Comyntas.—Very rare, only a few specimens taken, one of which I took on 26th June.

Lycaena Scudderii.—Fairly plentiful on and about 15th June, but very local around the food plant,—Lupin.

Pieris Napi.—Two or three specimens of a variety of this butterfly were taken on the 24th May, the only specimens observed.

Last season, on the 1st July, the variety Oleracea-aestiva was very common at the Forks of Credit, but on paying a visit there on the same date this year, not a single specimen was to be seen. In fact, very few butterflies of any species were noticeable.

Papilio Cresphontes.—A worn specimen of this butterfly was taken on the 24th September, at Weston, a few miles from Toronto, by Mr. Donald Wilby.

Collecting by electric light was also very poor this season. I do not know what has come over the Sphingidæ. For the last four seasons they have been very scarce. In 1893 as many as seventeen different species were to be taken, and most of these species were fairly common, while some of them were very plentiful. Deilephila Chamaenerii (Fig. 46) especially was very common in 1893. Even around the electric lights in the heart of the city numbers of specimens of D. Chamænerii were to be taken. During the last two seasons I have not seen a single specimen of this sphinx. Actias Luna was frequently observed this season, and as many as ten specimens were taken on the 27th May. Regarding the other moths which come to light, they were in most cases very scarce.

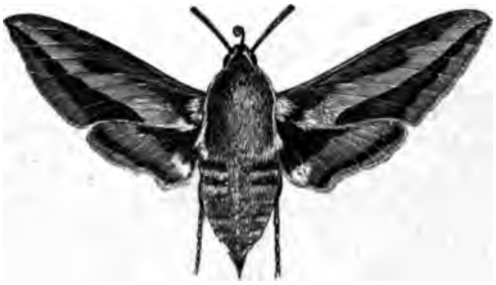

Fig. 46.

"Sugaring" also was poor, up to July 1st hardly a specimen being attracted to the sugar. After that date, however, several good noctuids were taken, but up to the present time I have not got them identified.

NOTES ON THE SEASON OF 1897.

By C. E. Grant, Orillia.

The season of 1897 was not a very good one from an entomological point of view, though, as is often the case in such seasons, some good captures were made here in Orillia, of which I made some notes.

Brephos infans was taken by me this year on April 11th for the first time in thirty years. Others were seen at a later date, but were too wild to capture. The locality was a road through a birch woods.

Thecla laeta —One specimen of this rare insect was taken by my friend, Mr. James Walker, in a cedar swamp not far from a running stream; the specimen was a female in good case. As the insect was taken on a cedar bush, it would have been interesting to know if this is the food plant of this species. I believe it is not known. I intend, if all is well, to thoroughly search this locality next May for a duplicate. The date of capture was May 12th.

Melitæa Harrisii.—Three specimens of this species were taken in the first days of July beside the railway track passing through a piece of low land. This insect is rare here.

Papilio troilus.—Took my first Orillia specimen of this butterfly on Asclepias in the month of August.

Lycæna comyntas.—This is also an addition to our fauna. The one I took this year was in a clover-patch at the side of the railroad. Date August 4th.

Colias philodice variety *nigra.*—On the afternoon of August 12th I was watching a large number of *C philodice* disporting themselves in a clover field when I was suddenly aware of the presence, amongst them, of a butterfly, which I was sure I had never seen before. I was much puzzled at the time as to what genus it belonged to. After a hard and long chase, and I am afraid to the detriment of the gentleman's clover, I captured it, and on examination I at once recognized it from the painting in "Edwards's Butterflies" in one of his places of Philodice. Of course it was not an exact reproduction, the bases of the wings on the underside being darker olivaceous, and the upperside being covered with long greenish hair near the bases, producing a pretty effect; it was altogether a handsome insect. Philodice was remarkably abundant this season, and the female in great variety. The albino specimens were nearly as numerous as the yellow type, and differed greatly in markings from each other.

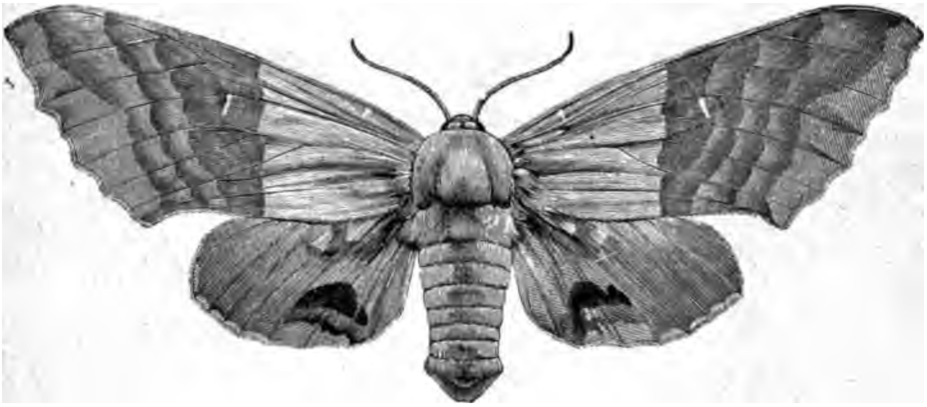

Fig. 47

Megalostoma cæsonia (Fig. 39).—I searched in vain for this eccentric butterfly this season, which last year was moderately common, but did not see a specimen. It will probably be due again in thirty years, as it is about that length of time since I captured it in my father's garden when a boy.

I had good success among the Sphingidæ, and captured no less than nineteen different species; most of these were taken at flowers in June and July, from one to three of each, with the exception of *Triptogon modesta* (Fig. 47), which was found at the base of a poplar, newly emerged from cocoon, and some which were taken at light; the abundance of *Smerinthus excæcatus* (Fig. 48) was remarkable, eight specimens coming into the house one evening in July, attracted by an incandescent light.

The long cold rains that succeeded the hot spell in the beginning of July apparently were too much for most of the destructive cut worms, as their imagoes did not appear (with the exception of *Agrotis telifera*, Fig. 49,) in any numbers. *Hadena devastatrix* and *arctica* and *Leucania unipuncta*, the army worm moth, were almost scarce—in 1896 *unipuncta* was so plentiful that I have killed over 500 on one post, on which I had placed my sugar for other victims; they were a perfect nuisance, coming in clouds before dark, and this occurred in June and again from the end of July through the season; notwithstanding this fact, the army worm was not reported as troublesome in our county, though I believe Ontario county was infested to some extent.

Fig. 48.

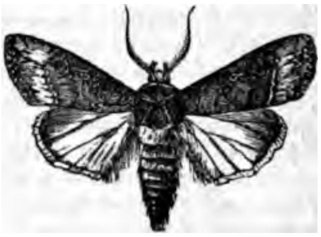

Fig. 49.

The following noxious insects were reported as plentiful around Orillia:

The tent caterpillar, *Clisiocampa Americana.* Fig. 19, also its confrere (*sylvatica*) the former, however, only lives in the neglected orchards, but the moth was extremely abundant.

The canker worm (*Anisopteryx pometaria*).—I never saw such quantities of this insect in the imago state as this year; in October it was to be found, male and female, on every roadside fence—with it was also conspicuous *Hybernia tiliaria*, the November moth, Fig. 50.

Carpocapsa pomonella, the apple codling moth,—this insect, though not often seen as an imago, is always plentiful here, but spraying the trees has had a wonderful effect in controlling this pest, and those orchards that are sprayed regularly *every* year produce as sound fruit as is to be found anywhere.

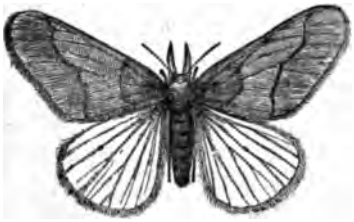

Fig. 50.

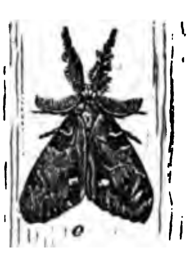

Fig. 51.
The male Tussock Moth.

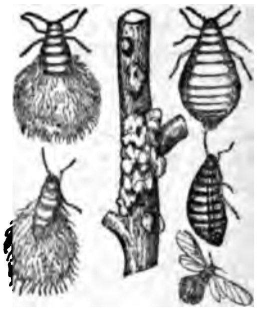

Fig. 52.
The Woolly plant-louse of the apple (*Schizoneura lanigera*).

Orgyia leucostigma, the tussock moth (Fig. 51), is evidently on the increase in Canada, from observation made here by myself. It seems that each year it is rather more plentiful. *Orgyia antiqua.*—This insect appeared in numbers this fall. I bred several females and whilst they were confined in the cage the air for yards around was literally full of the attendant males.

It was reported to me in the month of July that a great number of the maple trees in this town were apparently dying. As Orillia is one grove of these trees, the appearance of a pest was viewed by many of the inhabitants with great alarm. I examined a good many trees. I supposed at first that the borers *Clytus speciosus* or *Tremex Columba*, were the cause, but I could only account for the flagging energies of some of the limbs from the fact that nearly all the trees showing distress were largely covered in places with a woolly louse (*Schizoneura*), Fig. 52, which very much resembled the alder louse. I was not certain of the species, but I recommended kerosene emulsion, which I believe finished them, as the complaint ceased.

To a person who has always been imbued with a love of nature, to whom the war of the elements, the peaceful starlight night, the songs of the birds, the growth of a plant, the chirp of a cricket, the song of the Cicada, or the sight of an insect, alike send a thrill of pleasure through his mind and bring back a flood of pleasant recollections, I say to that person who has learned to love these things, it is almost impossible to understand how it is that so few people seem to obtain any pleasure from studying nature. To many there is no enjoyment but in business, and there are others who are always complaining that they do not know what to do to kill time. Just fancy this with the book of nature open before them and half, yes, nine-tenths, of its wonders unknown. To those in business who have very little time to spare (I myself am one of these), I would say that no more pleasant relaxation can be found, when once the science of entomology, botany, or their kindred sciences, is known sufficiently to interest one to further pursue it. I am satisfied that if the study of these things was brought before the young in the proper way, it would make the youth of this country more manly, more diligent in business, more cultured and gentlemanly, and that the crime records would decrease correspondingly. This may seem a rash statement, but I claim that any one who has learned to study and love the works of nature will seldom do a deed of violence, when in tender years an occupation is found with all the elements of amusement, free from the taint of vice. The famous Dr. Johnson once said, when he heard of a man committing suicide: "He would never have done so if he had known how to hem a pocket handkerchief," implying that the want of an occupation induced the crime. And so likewise the study of entomology would keep the minds of those who take to it in pleasant occupation, which would increase, instead of tailing as most other amusements do, as one by one the truths of nature were revealed; and I have every reason to believe that the interest would increase until the senses are benumbed with age, and this can be said of few earthly pleasures. The lack of interest is surely in the want of the first elements of knowledge of these sciences; but I trust that now entomology, from an economic point of view, is being studied, and the farmers and fruit growers of this country are awakening to the fact that to hold their own with their neighbors who have studied entomology, they must do so too—that ultimately the young will be taught it and the sciences of entomology and botany will form part of the curriculum of our public schools.

THE SAN JOSÉ SCALE.

(*Aspidiotus perniciosus*, Comstock.)

BY JAMES FLETCHER, DOMINION ENTOMOLOGIST, OTTAWA.

In our annual report for 1894 there appeared a short article upon the San José scale. As there stated, the unexpected discovery in the Eastern United States and British Columbia of this scourge of the Pacific coast orchards made it all important to draw the attention of Ontario fruit growers to the subject, so that they might become familiar with the appearance of the insect and be prepared to promptly adopt active measures to eradicate it should it, as was thought more than probable, appear in our province. During the same year a further article was also published in the *Farmers' Advocate*, urging fruit growers to be on their guard against the introduction of the San José scale with nursery stock.

Since that article was written it has been seen how well founded were the fears that this dreaded enemy might spread to Canada and be a cause of loss in our fertile fruit districts.

The San José scale, it is thought, was introduced into California about 1870 ; but it was not noticed as a serious enemy until 1873, when it was discovered to be in great numbers on fruit trees at San José, Cal , a fact which has given to the insect its popular name. Its original home is not certainly known, but Japan is suspected.

As far as can be learnt, it had not been scientifically described until 1880, when Prof. Comstock treated of it in his annual report as Entomologist to the United States Department of Agriculture. Dr. L. O. Howard tells us that Prof. Comstock designated it by the specific name *perniciosus* because he considered it the most pernicious scale insect known in the country. "It swarmed in countless numbers upon the trees in certain orchards, and infested all the deciduous fruits grown in California except the apricot and the Black Tartarian cherry. In the course of twelvé years the insect spread through all the fruit growing regions of California, through Oregon and into the State of Washington. It is known as the worst insect pest of deciduous trees on the Pacific coast and has caused great pecuniary loss. Many crops of fruit have been ruined and thousands of trees have been killed."

The above was written by Dr. Howard in April, 1893, since which time a great deal more than was then known has been learnt concerning this insect and its capabilities as an enemy to the fruit grower. It has been introduced into the east and, contrary to expectations, has shown that the climate of the Eastern United States is sufficiently well suited to its requirements for it to have developed so rapidly and with such deadly effects upon the trees infested that it has now become of national importance. It is at the present time acknowledged to be by far the most serious insect enemy of fruit trees which has ever been studied by practical entomologists. Owing to its very inconspicuous appearance and to the fact that it passes the winter attached firmly to the bark of fruit trees, it has been distributed widely and unwittingly by nurserymen with young fruit trees and now occurs in almost every State of the Union. It has also spread up into Canada, where it has been found on two or three occasions in British Columbia and has also established itself at a few places in the peach districts of Ontario. The first specimens of this insect received from an Ontario orchard were from the vicinity of Chatham in Kent county. This was in January, 1897. Very soon afterwards it was discovered that there were other orchards near Niagara and St. Catharines which had been similarly infested through fruit trees imported from the United States. The last discovered occurrence of this insect was made quite recently near Kingsville in Essex county, where three centres of infestation were found on one fruit farm, involving upwards of 300 trees. The above are all the authentic instances of the occurrence of the San José scale in Ontario which I have been able to learn of, although at various times during the summer several reports of infested orchards have been received. Upon investigation, however, these have proved to be occurrences of some other scale insect. In addition to several kinds of scale insects which were sent in for identification under the supposition that they were the San José scale, many other insects in no way resembling a scale insect were sent. From the many kinds of these belonging to various orders, it seems advisable to state that the San José scale is not an easily seen insect, resembling a beetle, a fly or a spider, nor has it well developed wings and legs, but it is a minute creature which can be detected only by the closest search and even then requires some skill and experience to recognize it as an insect. Among the objects which have been enquired about were many things quite unlike scale insects, but there were others which certainly do present very much the same appearance. Among these were certain minute fungi found on dead wood, and particularly the small corky excrescences known as lenticels which occur upon the young bark of many trees, as the apple, pear, birch, black walnut, etc. Their different nature may, however, be generally ascertained easily by the fact that they cannot be removed from the bark without tearing the tissues, while scale insects may be easily moved by gentle pressure as with the finger nail.

In view of the almost unanimous demand by fruit growers for protective legislation against this enemy, it became of much moment to find out as soon as possible what was the true state of affairs in the province with regard to its actual distribution and establishment in our orchards.

On June 10th a well attended meeting of fruit growers was convened at the orchard of Mr. Charles Thonger, near Niagara, when the subject was discussed at length. The necessity for everyone concerned being able to recognize the scale was brought out at this meeting and steps were immediately taken to supply an evident lack of knowledge on this point among Canadian fruit growers. Prof. J. Hoyes Panton, of the Government Agricultural College, at Guelph, prepared and issued promptly an excellent concise bulletin, which was widely distributed by the Hon. Minister of Agriculture and Arts, and at the same time a large illustrated wall poster, 2ft. 3in. by 1ft. 8in., was prepared by the Dominion Entomologist at Ottawa for putting up in Post Offices, Railway Stations, School Houses, Public Halls and other much frequented places. This was illustrated with figures of an infested pear and a piece of an infested branch, natural size, and also enlarged figures of the female insect and her scale. Warning was given that the San José scale was already in Canada and that if it were allowed to spread, great loss would surely be the result. The best way to identify the insect was given, together with advice as to the proper remedy and the way to apply it in case anyone should be unfortunate enough to find this public enemy on his trees.

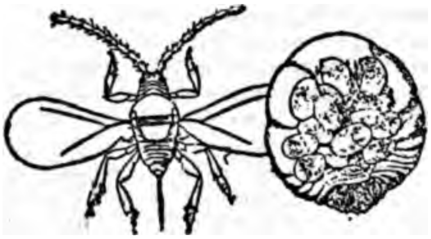

Fig. 53. Female scale, with a male adult to the left, greatly enlarged.

These sources of information were distributed widely amongst fruit growers living in those districts where the San José scale was likely to occur. In addition to the above measures, by instruction of the Hon. John Dryden, special attention was paid to this subject by Mr. W. M. Orr, the Superintendent of Spraying Experiments, and every effort was made to find out to what extent orchards were infested. Whenever the scale was found, active measures were at once put in force to secure its eradication. Collections were made of the scale upon various fruit trees and show cases were exhibited in the more important autumn exhibitions, which were attended by Mr. Orr, who was untiring in his efforts to explain to visitors the nature of the insect and warn all against neglecting it. In every instance where this pernicious insect has been found on trees in Canada the owners have done their utmost to destroy it, sparing no expense of labor or material. All were easily convinced by the fatal effects of its presence on their trees that this was no ordinary insect pest they had to fight against.

What is the San Jose' Scale? The San José scale is a very small (about one-tenth of an inch in diameter), round, flattened and inconspicuous scale insect, that is, a sucking insect like the well-known Oyster-shell Bark-louse and the Scurfy Bark-louse, covered by a waxy scale which, as we find it on trees, is the only part visible except in the early larval stage, when scale insects, for a few days, have the power of walking.

The exact identification of this species is a matter of some little difficulty, for there are at least two other scales occurring on fruit trees in Canadian orchards, the Putnam Scale (*A. ancylus*, Put.), and the Forbes Scale (*A. Forbesi*, Jnsn), which superficially so closely resemble the San José scale as to render it necessary for a specialist who has studied the matter before hand, to examine the mature females under the microscope and that after boiling in caustic potash, before the difference can be made out. Moreover, both of these scales occasionally may be found in vast numbers upon an infested tree, but the exac identification is, nevertheless, a matter of great importance because it has been found by experience that neither of these scales causes very serious injury to fruit trees as compared with the San José scale. This is chiefly due to the fact that they seldom spread from tree to tree with anything like the rapidity of the last named species. Indeed, the occurrence in very large numbers of a scale insect upon a tree cannot always be taken as conclusive evidence that the species is a dangerous one, for it has frequently been noticed that scale insects may be present in enormons numbers upon a special tree, even killing it, and yet not be found at all upon trees of the same sort growing close by. In the case of the San José scale, on the other hand, if other trees are reasonably near, it is almost certain that they will soon become infested, and when a severe case of infestation is found, one of the first things looked for when considering whether the pest is actually the San José scale or one of some other species which superficially resembles it closely, is to notice whether the surrounding trees are infested also.

This important difference of habit in spreading and the much more fatal effects upon the trees from the presence of the San José scale, make much more stringent measure necessary to secure its eradication than with many other species, even frequently rendering it advisable, or imperative, to destroy many trees, or even whole orchards. This being the case, the very great advantage is obvious of being perfectly sure as to the identity of an infesting scale insect before valuable trees are condemned to destruction.

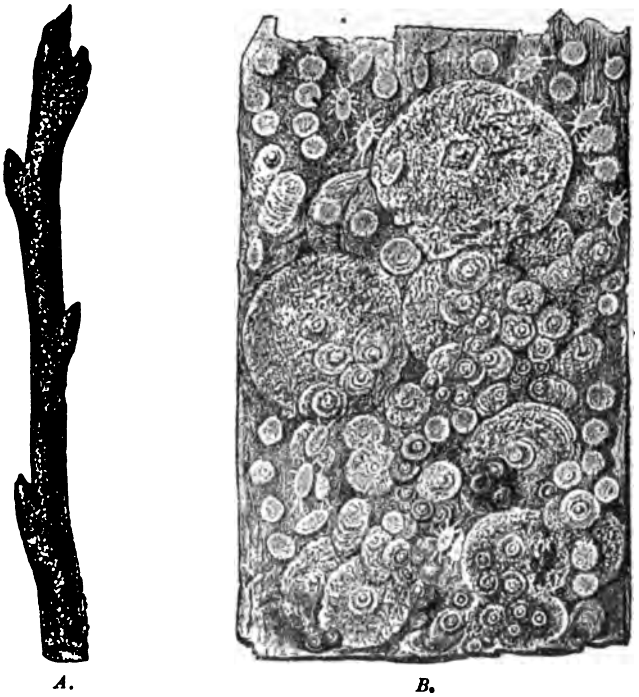

Fig 54. Appearance of scale on bark ; *a*, infested twig—natural size ; *b*, bark as it appears under hand lens, showing scales in various stages of development and young larvæ.

The following description of the San José scale and its life history are taken from the annual report of the Entomologist and Botanist of the Dominion Experimental Farms for 1897 :

How to know it.—The general appearance of the bark of infested trees is dirty, scurfy and grayish in color, as though dusted with ashes. The scales usually are found in enormous numbers, frequently overlapping or occurring altogether on the top of older scales ; they may be found throughout the summer of all sizes, from the newly hatched mite-like larvæ to the full-grown insects. In severe cases of infestation this massing of the scales produces a scurfy appearance of the bark, which when once seen is easily recognized. On young twigs and fruit and leaves, there is usually a well defined purplish ring surrounding each scale, and although this purpling effect is produced by a few other scales, such as the Putnam scale (*A. ancylus*, Put.), it is particularly characteristic of the San José scale, and even upon large branches, although invisible at the surface, may be found by cutting away some of the bark.

The scales of the males and females differ somewhat in shape.

Female:—Scale very thin, almost circular in outline, much flattened; size ranging from one-twentieth to one-eighth of an inch in diameter white at first, becoming grayish or blackish, and later much blackened by the fungus *Fumago salicina*, so common on trees attacked by many kinds of bark-lice and plant lice. In the centre of the scale is a small dark or yellowish nipple-like elevation surrounded by a distinct circular darkened depression, which, as pointed out by Prof. Webster, is one of the best distinguishing marks between this scale and some closely allied species.

Male:—Scale about half the size of that of the female, rounded-oblong, with the nipple-like elevation nearer one end than the middle.

Life History.—The winter is passed by the partially grown insects beneath their scales. With the return of warm weather next spring growth is resumed, and the males reach maturity a few days before the females. They are extremely small two-winged flies, and when examined under a magnifying glass are found to have orange-yellow bodies, iridescent dusky wings and black eyes. The minute creatures have no mouths, so can take no food; consequently, having fertilized the females, they very soon die. The date when the females become full grown and begin to produce young varies, of course, with localities and climate. In Arizona the young larvæ are recorded as appearing in March. At Washington it is by the middle of May; in the State of New York, early in June; at Amherst, Mass., they were first noticed 12th June; and, as far as I can learn, between the middle of June and 1st July in our Niagara district. Most careful observations have been made under direction of the U. S. Entomologist, by Mr. Theo. Pergande. The following condensed life history is compiled chiefly from U. S. Div. of Entom. Bul. No. 3, N.S., in which Mr. Pergande's observations are recorded.

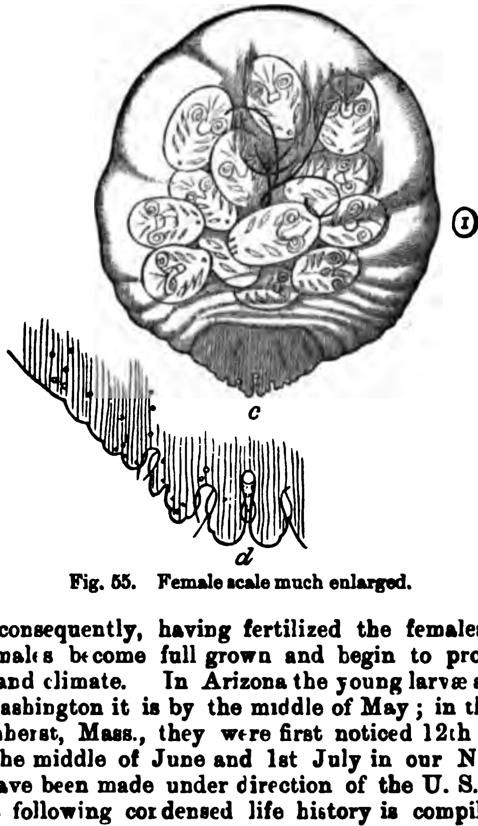

Fig. 55. Female scale much enlarged.

The adult female gives birth to living young, differing in this respect from most other scale insects. Ordinary, as with the Oyster-shell Bark-louse, eggs are laid beneath the scale, which in the course of a longer or shorter time hatch and the young larvæ migrate to different parts of the plant; but in the case of the San José scale young are produced day and night for a period of nearly six weeks before the exhausted female perishes, and this at the rate of about nine or ten every twenty-four hours.

After birth the young larva remains motionless for a short time beneath the scale of the mother, it then forces its way out and runs over the plant, seeking a suitable place to settle. It is a microscopic creature, pale orange in color with an oval body, six legs and two feelers. The long, thread-like proboscis with which it sucks the sap of the plant, is doubled on itself and lies in a groove of the body wall After crawling about for a few hours, the larva settles down and works its bristle-like sucking tube through the bark and remains fixed, if it be a female, for life; and if a male, until fully developed, when it will have a few hours more, during which it can fly about.

The development of the scale begins even before the larva becomes fixed. The secretion starts in the form of very minute, white, waxy filaments, which spring from all parts of the body and rapidly become more numerous until within two days the insect is entirely concealed by a whitish shell or scale, which now has a prominent central nipple. The scale is formed by the matting and melting together of the waxy filaments. As in the development of most insects, there are distinct periods of the larval life, divided by moults of the skin, and in the case of the male scale insects marked by important structural changes. The first moult takes place when the larva is twelve days old. Up to this time the male and female scales are exactly similar in size, color and shape, but after the moult the insects beneath the scales bear no resemblance to each other. The males are rather larger than the females and have large, purple eyes, while the females have lost their eyes entirely. The legs and feelers have disappeared in both sexes. Eighteen days after birth the second moult occurs and the males change to the first pupal condition (pro-pupa) the small scales now assume an elongated shape. the legs and feelers have re-appeared and there are now two prominent wing pads extending along the sides of the body. About twenty days after birth the male insect changes to the true pupa, in which all the parts shown in the pro-pupa are more developed and a slender organ at the end of the body, called the style, has appeared. From four to six days later, or from twenty four to twenty-six days after birth, the males mature and back out from the rear end of their scales. This is chiefly by night or in the evening.

The changes which have gone on beneath the female scales are less striking than those described above. After the first moult, the body of the female is practically an almost circular flattened sac, with indistinct segmentation and without organs, except the long sucking bristle with which it sucks up continuously the sap of the tree it is infesting. The female moults a second time about twenty days after birth and the last segment now shows the important characters of the mature female which are of so much service in the exact identification of the species. The segmentation of the body at this stage is quite distinct.

Thirty days from birth the females are full grown and the embryonic young may be seen within their bodies. The mature female, prior to the development of the young, is 1/30 of an inch wide and 1/25 of an inch long.

The length of time necessary for the development of a generation varies somewhat, and according to the Washington observations covers a period from thirty-three to forty days from the time the young larva appears until it develops into a mature female, bearing young. The San José scale is enormously prolific. It has been calculated that a single female may be the progenitor of 3,216 million descendants in a single season.

A most serious Enemy.—It cannot be too often repeated that the San José scale is one of the very worst enemies that the fruit grower has ever had to deal with. Its inconspicuousness and presence upon trees in a dormant condition at the time when these or scions from them are distributed, render it liable to be overlooked. Its great power of increase when introduced into a new locality and the fatal effects of its attacks on trees, as well as the extensive range of food plants it will attack, which includes nearly every deciduous tree and shrub, added to the difficulty of treating it effectively, all combine to make this insect what it is acknowledged by most to be, as stated above, one of the worst insect enemies we have ever had to contend with.

Notwithstanding this, there is always a tendency among those who are not well informed, to minimize the danger and neglect the necessary precautions. On this point it may be well to give the following short quotations from two of the leading economic entomologists of the United States:

Prof. Webster, of Ohio, says in his official report to the Ohio State Horticultural Society: "The statement has been made that 'the scale is not a particle more destructive than many of our native species of injurious insects or than those to which we have become used;' but anyone who is at all familiar with this pest understands that this is not at all the case, and that we have no other insect that is so deadly in its effects or so difficult to detect until it has become fully established, and certainly we have nothing in Ohio which, if it gets on to a tree, is as sure death. Besides, such talk as this only makes the enforcing of remedial or protective measures more difficult."

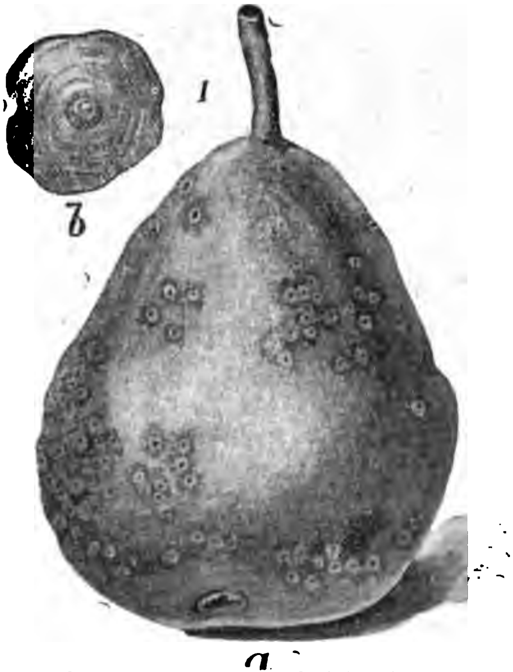

Fig. 56, San Jose Scale. *a*, pear moderately infested; *b*, female scale enlarged.

Dr. J. B. Smith, speaking before the Moorestown (N. J.) Farmers' Institute in December, 1897, says: "The San José scale is without doubt the most important of the fruit pests with which the fruit growers of this section must deal. I say 'must deal' advisedly, because developments during the latter part of last summer and even since then have made it certain that the San José scale is so firmly established in our State that its extermination can no longer be considered a possibility."

After treating of the extent of the infestation in the State of New Jersey, Dr. Smith says: "The scale must be dealt with, or you must abandon fruit culture. It can be dealt with if intelligent effort is made. The treatment is not easy and at first is expensive. It is for the fruit grower to decide whether his orchards are worth it. If not, he had better destroy them at once and plant something else."

REMEDIES.

Cutting down.—When a tree is found to be heavily infested with the San José scale, the cheapest plan will generally be to cut it down at once and burn it, for it is probable that a tree which has once been badly attacked will never recover its full vigor, even although every scale is killed.

Whale-oil Soap.—If, however, a tree is only slightly infested or there are special reasons for trying to save it, it should be pruned back as closely as it will stand and then washed thoroughly two or three times with whale-oil soap (two pounds of soap to one gallon of water). This is an expensive treatment, but, on the whole, it is the most effective yet discovered.

Kerosene Emulsion.—A treatment which has given equally good results, but a little more trouble on account of the extra labor, is to spray the trees as soon as the leaves fall in the autumn with kerosene emulsion (Riley-Hubbard formula diluted with four or five times its volume of water, and then before the buds expand in the spring apply the two pounds to one gallon whale-oil soap wash.

Dr. Howard found after many experiments that what is required for spraying purposes is a caustic potash and fish oil soap which does not contain over twenty-five or thirty per cent. of water. Mr. Marlatt of the United States Division of Entomology, states that a new brand of soap known as Good's Caustic Potash Whale-oil Soap No. 3 is one of the best which has been put on the market.

Pure Coal Oil.—A great deal of attention has lately been drawn to the treatment of trees with pure kerosene or coal oil to free them from the San José scale. This matter was first brought forward publicly by Prof. Webster three years ago, and pure coal oil had also been used with success previous to that in 1893, by advice of Dr. J. A. Lintner, upon the trunks of peach trees infested with the Peach Bark-borer (*Phlœotribus liminaris*, Harris). (Cent. Exp. Farm Report, 1893, p. 216.)

Prof. J. B. Smith, of New Jersey, has experimented extensively with kerosene and claims that, when the work is done carefully and as he advises, the scale insects are killed by this treatment better and more cheaply than by any others, and without injury to the trees.

My own experiments with coal oil have been too limited and irregular in results to justify me in recommending this method, and Prof. Webster, when reporting upon his experiments says: "I own that for a time I hoped it was possible to use coal oil in destroying the scale without injury to the trees; but our experiments up to date indicate that except on the apple and some of the more hardy of the other fruits, and in cold weather, it is exceedingly dangerous to attempt its use; and, until we have had time to make further investigations, I wish to warn against its use otherwise than as above indicated." On the other hand, Prof. Smith and Mr. C. L. Marlatt have found that trees can be sprayed even in summer when in full leaf with pure kerosene and no injury result to the plant. Prof. Smith's instructions are as follows: "Spraying should be done with the finest Vermorel nozzle and with force enough behind it to send out an absolutely mist-like spray. Cover fully, but no more, that there may be no running down or lodging in forks or getting around the trunk down to the roots. The whole aim should be to put on the thinnest complete film possible. Spraying should be done on a clear, dry day, that evaporation of the kerosene may not be interfered with. The oil acts at once on the insect, and as soon as its work is done, we want to get rid of it as fast as possible. The trees should be dry when sprayed. If they are wet the oil will not penetrate, but remain as a film over the moisture until it disappears."

The details of the above treatment are given here because there has been so much inquiry about it by Canadian fruit growers who have seen Prof. Smith's recommendation, and it is doubtless advisable for those having infested trees to experiment upon a few of them and if good results are obtained many valuable trees may be saved.

Gas Treatment.—For thorough work in treating infested trees, the fumigation with hydrocyanic acid gas seems in California to have given the best satisfaction. This method, however, is expensive and the materials used are intensely poisonous However, for large nurseries where many young trees have to be disinfected before being sent out, this is stated to be the best method and is very generally adopted by the large American nurseries.

The plants are placed under a canvas tent made air tight by painting it twice with linseed oil. The first coat must be quite dry before the second is applied. The size of the tent is immaterial, but must cover the trees entirely, and the edges of the tent should be long enough to lie on the ground so that the tent may be perfectly air-tight by having earth thrown upon the lower edge to prevent the gas from escaping. The latest formula for generating the gas is as follows :

Cyanide of potassium (98 per cent)	1 ounce
Sulphuric acid (66°)	1 ounce
Water	2 ounces

for every hundred feet of space to be fumigated. Put the acid and water in an earthenware vessel large enough to prevent spattering, then place the jar under the tent and add to it the cyanide of potassium and close the opening quickly. The trees should be treated for at least forty-five minutes, when it will be found that insects of all kinds have been destroyed.

For the treatment of nursery stock prior to shipment large air-tight chambers or boxes are made in which the trees are placed.

Warning.—There is at the present time a great demand on the part of fruit growers for protective legislation both from the Provincial and Dominion Governments, and it is possible that something may be done in this direction; but, in the mean time, I would urge upon fruit growers and every one else to protect themselves and the country at large by putting into practice what after all are only ordinary common-sense measures of precaution. Foremost among these are certainly the exercising of the greatest care possible in buying nursery stock. As far as we have been able to learn, none of our Canadian nurseries are yet infested. Therefore, stock purchased at these nurseries, if grown in Canada, must be much safer than any that can be imported from nurseries in the United States which are known to be infested. Owing to the difficulty of detecting the scale on trees when it only occurs in small numbers, and to the fact that it infests almost every kind of plant likely to be imported, I do not consider it safe to accept for this insect the guarantees sometimes given by nurserymen that stock is free from infestation. It will be far better for Canadian growers to do without imported trees altogether, for a year at any rate, until we see the effects of the wise and active measures towards the eradication of this pest which are now being taken by the Department of Agriculture and Arts of Ontario, rather than by purchasing from United States nurseries to run the risk, however slight that may be, of bringing in more infested stock. Every effort is being made to discover and wipe out all cases of infestation, and I feel confident that, if energetic measures are adopted now, even the San José scale, as it now occurs in Canada, can be controlled.

NINTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, DETROIT, MICH., AUG. 12-13, 1897.

The Association met in room 212, Central High School building, immediately following the adjournment of Section F. Thirteen active members were present, together with many visitors, prominent among the latter being Dr. C A. Dohrn, Prof. E. B Poulton, Dr. C. P. Hart, Dr. C. S. Minot, and Dr. C. W. Stiles The Association was called to order by the President, and in the absence of Secretary Marlatt, Mr. A. H. Kirkland was chosen secretary *pro tem.* The address of the retiring president, Prof. F. M. Webster, treated of "The Present and Future of Applied Economic Entomology in the United States," and contained, among other very interesting features, an admirable tribute to the value of the systematist and a somewhat caustic criticism of the "species maker," helpful suggestions for the Experiment Station worker, and a very frank discussion of the unfortunate results which attend the attempts sometimes made to combine politics and science.

The following were elected to active membership :

A. T. Britton, New Haven, Con.
G. B. King, Lawrence, Mass.
Gerald McCarthy, Raleigh, N.C.
E. P. Felt, Albany, N.Y.
A. F. Burgess, Malden, Mass.
W. B. Barrows, Agricultural College, Mich.
R. H. Pettit, " " "
W. S. Blatchley, Indianapolis, Ind.

The following were elected foreign members :

Claude Fuller, Richard Helm, both of Perth, West Australia, and W. W. Froggatt, Sydney, New South Wales. These additions increase the numbers of this Association to 93 active and 31 foreign members.

Prefacing his remarks with a brief review of the damage by the larvæ of *Orgyia leucostigma* in Washington during the summer of 1895, and the important influence of parasites in controlling this outbreak, Mr. Howard presented the following papers :

ADDITIONAL OBSERVATIONS ON THE PARASITES OF ORGYIA LEUCOSTIGMA.

In Bulletin No. 5, Technical Series, Division of Entomology, United States Department of Agriculture, entitled "A study in Insect Parasitism," it was shown that following an extensive attack by *Orgyia leucostigma* upon the shade trees of Washington, which culminated in August, 1895, there was an extraordinary development of parasites. Thirty-five true parasites were reared, of which fifteen were primary hymenopterous parasites and six primary dipterous parasites, fourteen species being hymenopterous hyper-parasites. In the autumn of 1895 about 90 per cent. of the caterpillars were destroyed by primary parasites, the vast majority of these being hymenopterous and the bulk of the work being done by *Pimpla inquisitor* and *Chalcis ovata.* In the spring of 1896 so many of these primary parasites had successfully hibernated that they were in position to almost annihilate the first brood of caterpillars, already weakened greatly in numbers by the extensive parasitism of the previous autumn. In the later months of 1896, however, an extensive hyper-parasitism began to be effective, and the principal primary parasite, *Pimpla inquisitor,* was almost killed off by its own hymenopterous parasites and principally by *Dibrachys boucheanus.* Tertiary parasitism was noticed at this time, but was not especially effective, and the Orgyia had begun to recuperate in numbers at the close of 1896. Several careful accounts in July, 1896, showed the percentage of parasitism to be 98.8 per cent., and the numerical details of the parasites concerned were found in one instance to be as follows :

On June 30 and July 8, 1896, 624 cocoons of the tussock moth were collected without discrimination from the trunks of trees in the United States Department of Agriculture park. From these 624 cocoons issued the following parasites:

	Specimens.
Pimpla inquisitor	729
Bathythrix pimplæ	13
Limneria valida	1
Theronia fulvescens	1
Chalcis ovata	69
Dibrachys boucheanus	50
Asecodes albitarsis	1
Frontina aletiæ	7
Frontina Frenchii	14
Tachina mella	12
Euphorocera claripennis	15
Exorista griseomicans	4
Total	916

The part played by dipterous parasites up to the winter of 1896, when the bulletin in question was published, had not been great, only 187 specimens in all having been reared. All the species were well-known Tachina flies of wide distribution and general parasitism.

A recuperation in numbers of the Orgyia was quite marked in the spring of 1897, and additional and heretofore unreported observations were made. So great had been the destruction of *Pimpla inquisitor* that in these observations this species did not appear in a single instance! Another hymenopterous parasite, *Chalcis ovata*, became prominent, and it is worthy of note that while secondary parasites of this species are strongly suspected, it is not absolutely known to have any, A striking feature, however, was the great increase in the number of the dipterous parasites. The rearings were conducted on a large scale, and the following table affords an interesting comparison to the one just given.

Five thousand larvæ and pupæ of *Orgyia leucostigma* were collected July 6 to 9, 1897. From these there had issued up to August 2 the following parasites:

	Specimens.
Tachina mella	220
Frontina Frenchii	355
Euphorocera claripennis	464
Exorista sp	13
Helicobia helicis	4
Phorocera sp	45
Chalcis ovata	551
Apanteles parorgyiæ	3
Dibrachys boucheanus	10
Total	1,665

Of these it will be noticed that more than two-thirds (1,101) were dipterous, while the previous summer dipterous parasites had constituted only about one-twentieth of the number reared.

From the 5,000 cocoons there issued also 321 male moths and 764 female moths; 146 of the caterpillars or chrysalids died from a disease which we have for convenience called "black rot," and 33 from another disease which for the same reason we have called "red rot."

In percentages the result may be expressed as follows:

	Per cent.
Moths	21.07
Dipterous parasites	22.02
Hymenopterous parasites	11.02
Disease	3.58
Total	57.69

This leaves about 2,000 chrysalids dead from causes not yet ascertained. From careful examination of a small proportion of them it seems probable that from 400 to 500 have been killed by parasites which have died without emerging. There still remain also about 200 dipterous puparia in the rearing cages, from which the adults may still emerge. That the majority of the remainder have died from disease seems probable. The mortality ratio was, therefore, 79 per cent., as against 98.2 per cent. at a corresponding time last year; and, while last year hymenopterous parasites were responsible for nearly the whole of the mortality, this year they brought about not more than 15 per cent.

These additional observations only accentuate the extraordinary features of the parasitism of this lepidopterous insect. The multiplicity of factors upon which its increase and decrease depend and the important interrelations of the species concerned are astonishing to one who has not especially studied this phase of insect life.

TEMPERATURE EXPERIMENTS AS AFFECTING RECEIVED IDEAS ON THE HIBERNATION OF INJURIOUS INSECTS.

It is a well-known fact among agriculturists and horticulturists that winter weather of a steadv degree of severity is more favorable to plant growth than an open winter with alternating freezes and thaws. With regard to certain injurious insects it has become an accepted idea among economic entomologists that this same principle will hold, yet the question comes to all of us from farmers and others with a considerable degree of frequency as to whether a given winter which has been unusually severe will not have resulted in the destruction of injurious insects to such an extent as to promise comparative immunity the coming season. We have been obliged, or at least the writer has been obliged, to answer such questions theoretically. There has been no exact experimentation, so far as he is aware, along this line. It is, therefore, with pleasure that he calls attention to the results of recent experimentation by Dr. Albert M. Read, of Washington, the manager of the cold storage department of the American Security and Trust Company, and the same gentleman who conducted the experiments on the effect of cold storage upon household insects referred to in a paper read by the writer before the last meeting of this association. Dr. Read has found in the course of his experiments, which have now extended over two years, that a constant temperature in the neighborhood of 18° F. will not destroy the larvæ of *Tineola biselliella* or of *Attagenus piceus*, but that an alternation of a low temperature with a comparatively high one invariably results in the death of the larvæ of these two insects. For example, if larvæ of either which have been kept at a temperature of 18° F. are removed to a temperature of from 40° to 50° F. they will become slightly active, and when returned to the lower temperature and kept there for a little time will not revive upon a transfer to the warmer temperature.

It is thus rather satisfactory to have experimental proof in support of previously accepted but more or less theoretical ideas.

Mr. Rolfs had noticed that after severe frosts and cold in Florida there was an abundance of northern insects, especially Orthoptera.

Mr. Craig described the severity of the winter of 1896-97 in Canada, when there was severe cold but little snow. This year, throughout southern Canada, plant-lice were present in tremendous numbers on apple, plum, cherry, and other trees.

In the general discussion which followed, the fact was brought out that plant-lice had been particularly abundant throughout Canada and the United States during the past summer.

Mr. Howard pointed out the fact that this abundance was probably due to the wet weather of late spring and early summer, which had checked the feeding and multiplication of the natural enemies of the plant-lice.

Mr. Minot stated that in the vicinity of Milton, Mass., injurious insects had been quite scarce during the past summer; fewer potato beetles had been noticed than for many years, while rose-chafers and tent-caterpillars were equally scarce. He also had noticed the great abundance of plant-lice early in the season, but after the extreme hot weather of the first week of July their numbers greatly diminished.

Mr. Howard emphasized the fact that hot weather played a very important part in controlling plant-lice. He cited an instance where, several years ago, Mr. Barrows had called his attention to the extraordinarily large number of plant-lice upon certain shade trees of Washington, D.C. The following day the temperature reached the maximum of 100° F., and as a result the plant-lice disappeared like magic.

Mr. Ashmead called attention to the fact that the family of plant-lice was not extensive in the tropics, thus supporting the theory previously discussed.

Mr. Barrows stated that the condition in Michigan regarding plant-lice was probably the same as that in Canada. He was of the opinion that the great abundance of these insects in Michigan during the past summer was probably due to the large number present last year. While examining the orchards for the San José scale last winter his attention was attracted by the remarkable quantities of plant-lice eggs deposited on young nursery stock and on orchard trees. So numerous were these eggs in some cases that the trees had the appearance of being varnished. His experience agreed with that of Dr. Howard, that hot weather was a most important factor in controlling the increase of plant-lice. Referring to Mr. Howard's first paper, Mr. Barrows spoke of the general lack of appreciation of the value of such experiments as those described and the lack of careful observations concerning the relation of temperature effects to the increase or decrease of injurious insects in connection with the abundance or absence of their natural enemies. A man might have observed a decrease or increase over the normal of the temperature for the winter of 1895-96 and arrived at the conclusion that this had been the chief factor in checking the outbreak of the Orgyia caterpillar, thus neglecting to take into account the action of the parasites. There was great need for careful and exhaustive observations whenever temperature effects are associated with the abundance or scarcity of any insect.

Mr. Webster called attention to the fact that the great numbers of aphides in Ohio nurseries this year had seriously injured a large quantity of young, rapidly growing stock.

An abstract of "Notes on Certain Species of Coleoptera that Attack Useful Plants," by F. H. Chittenden, was read by the Secretary *pro tem.* These notes treated chiefly of the food plants and habits of certain Chrysomelids. "An Experience with Paris Green," by T. D. A. Cockerell, was also read by the acting Secretary.

A letter from Miss E. A. Ormerod called particular attention to the fact that the house sparrow had been very abundant and very obnoxious in certain parts of England, and it seemed probable that some legislation or public measures would need to be adopted to control this bird. The arrival from Tripoli of a cargo of wheat, badly infested by the Angoumois moth, was recorded and reference made to the occurrence in injurious numbers of *Xyleborus dispar* at Toddington.

Prof. P. H. Rolfs presented notes on "A Fungus Disease of the San José Scale." This disease seems to be confined to the southern part of the United States, but is very helpful to fruit growers there. The scale has been almost eradicated from several orchards by means of it. Laboratory and field experiments now in progress promise hopeful results, but it does not seem probable that this disease will be of value in the northern part of the United States, since warmth and moisture are necessary for its development.

The next paper, treating of the same insect, was presented by Mr. Barrows :

THE PRESENT STATUS OF THE SAN JOSÉ SCALE IN MICHIGAN.

So far as we have any knowledge, the San José scale first came to the notice of the State Experiment Station May 14, 1896, when it was found on a single fruit tree in Jackson, and the tree was destroyed soon after. The origin of the affected tree was not ascertained, and as no other occurrences were reported from the vicinity it was supposed that no further trouble would result. In December following, however, it became evident from its invasion of the States adjoining Michigan on the south that our own State was in serious danger, and on application to the New Jersey nurserymen who were supposed to have sent out infested stock, a list of several hundred Michigan addresses was received by the horticulturist of the station, and a circular letter describing the scale and its work was sent to each address. Comparatively few replies to this letter were received, but among them were some which indicated the presence of the scale, and further enquiries showed its presence in several places.

During the winter many different parts of the State were visited in quest of the pest, but the severe weather, the lack of time, and especially the number and extent of the suspected orchards, made anything like thorough inspection impossible. The scale was located in greater or less abundance at half a dozen widely separated points, and this number has been increased by as many more through correspondence and the transmission of specimens. At present the scale is positively known to have existed in the ten counties, and in no case is there positive proof that it has been entirely eradicated.

In Ottawa County the infested stock was received from New Jersey in the spring of 1890, and thus had been established almost seven years before it came to the knowledge of any entomologist. During this time it had killed all or nearly all the trees on which it was brought, and had spread to all the other fruit trees in the immediate vicinity, some of which also had succumbed. Probably at this place several acres were badly infested, and of course it is to be feared that the scale has been carried to other orchards in the neighborhood.

In Ingham County one locality was found in the city of Lansing where the fruit trees about two houses and in their gardens were badly affected, and the scale had overrun rose bushes, currant bushes, grape vines, and even one or two shrubs of Spiræa. In this case the scale was originally brought on pear trees which were bought from a resident dealer in 1888 or 1889. The trees were said to have been obtained in New York State, but, as the dealer is known to have been unreliable, and as very few trees were true to name, it is not likely that any dependence can be placed on the statement. It is more than probable that the stock came from New Jersey, and that other parties in the vicinity have introduced the scale through the same dealer.

In still another case (and county) a dealer is known to have handled stock which was infested with the scale, and that at least five or six years ago, so that it is fair to assume that this pest is now pretty widely and thoroughly distributed through the fruit-growing parts of the State, and we may expect to find it in large quantities in all the counties of the four southern tiers, and yet farther north along the west side of the State. Since the scale thrives in Ingham and Ottawa counties it is likely to winter safely still farther north, and as yet the life zones in Michigan are so poorly defined that it is impossible to draw any line beyond which we may safely predict that the scale cannot live. * * * When we know more of the geographical distribution of life in Michigan, it may be possible to define with precision the limits beyond which the San José scale will not become established, but at present we must consider the entire southern half of the Lower Peninsula as in danger of serious infestation, together with a strip of uncertain width bordering Lake Michigan at least as far north as Grand Traverse Bay.

It is too early yet to make any predictions as to the ultimate success or failure of attempts to limit by legislation the spread of the scale in Michgan. The last legislature passed a bill which takes effect late in the present month (August) requiring the inspection of all nursery stock offered for sale in the State, whether home grown or from outside, and compelling inspection and treatment of all suspected orchards or fruit trees wherever found. The bill as originally drawn was not, of course, altogether satisfactory, either to the nurserymen or the fruit growers, and during its passage through the legislature its strength was still further impaired by sundry concessions which seemed to be necessary in order to secure its adoption. It is hoped, however, that its provisions may be thoroughly enforced and its efficacy tested during the coming year, so that, if necessary, better measures may be provided by our next legislature.

In the discussion which followed these two papers, Mr. Craig stated that the condition in Canada relative to the San José scale was quite similar to that of Michigan. This insect had been found in British Columbia and in Ontario. In the latter Province there were seven well authenticated occurrences, these being probably in the upper austral region. Mr. Craig's investigations showed that the San José scale had been present in Canada for at least four years and came originally from two New Jersey nurseries, whose proprietors had kindly enabled him to trace the shipments of infested stock. Mr. Craig was of the opinion that the scale would do the greatest damage in the peach-growing region where, as early as July 1, 1897, he had found the young scales securely fixed on young, growing wood. Fungus cultures, received from Professor Rolfs, had been used in inoculation tests in the laboratory, but with no practical results as yet. It seemed probable that an endeavor would be made to obtain legislation with a view to preventing the shipment of infested nursery stock to Canada.

Mr. Howard inquired as to the known geographical distribution of the fungus disease. Mr. Rolfs said that, to the best of his knowledge, this disease was chiefly confined to the southern part of the United States. It had been found in Alabama, Georgia, South Carolina, and in one instance in Pennsylvania. It was most abundant at Auburn, Ala.

A paper from Prof. C. P. Gillette on "Insects taken at Light and Sugar," evoked considerable discussion, and was followed by "A Study of the Possible Origin and Distribution of the Chinch Bug," by Prof. F M. Webster. The author advanced the idea that this insect had originated in the southern part of the United States and spread by two diverging streams up the Mississippi valley and along the eastern Atlantic coast. In the former region the long winged form predominated, while the coast form was short winged. In the discussion following this paper the general opinion seemed to be that the length of the wings depended upon environment rather than heredity. Mr. C. W. Mally recorded the capture at Ohio of a specimen having one long and one short wing, thus throwing additional light upon the relationship between the two forms.

"Notes on the Common House Fly," by Mr. Howard, gave the negative results of a series of experiments with lime, land plaster, etc., used to destroy the larvæ of the house fly. He emphasized the necessity of greater cleanliness in the management of horse stables

A paper from Mr. Gillette on "Vernacular Names of Insects," was read and referred to a committee consisting of Messrs. Howard, Fernald and Lintner. A communication from C. P. Lounsbury, giving very interesting notes on "Cape of Good Hope Insects," particularly the locusts of that region, was then read.

Mr. H. G. Hubbard presented an account of the "Insect Fauna of the Giant Cactus," recording the capture of a large number of insects on this plant and giving notes on their habits.

Mr. Howard described "A Valuable Coccid," lately discovered in Arizona and New Mexico, from which, by suitable treatment, a good grade of white wax could be obtained.

The refuse from this operation is of the nature and consistence of India rubber and may be of commercial value.

"Notes on Insects of the Year," by Messrs. Webster and Mally, recorded interesting experiences with several of the common insect pests. The negative results of a series of experiments with kainit, against the insects attacking the roots of the grape, caused considerable discussion, and the need for further experimentation along this line was pointed out.

A paper by A. H. Kirkland on "Preparation and Use of Arsenate of Lead," detailed a method of preparing this insecticide at a cost of about seven cents per pound. Work against the gypsy moth was mentioned, and the condition of the infested region was reported as generally better than that of last year. This undertaking, however, is still handicapped by insufficient financial support.

"A Malodorous Carabid," by Mr. Barrows, gave extensive notes on the annoyance and discomfort caused by the almost unbearable odour of this insect, *Nomius pygmæus*.

Among the papers read by title only, owing to the absence of their authors, but afterwards presented in the official report of the meeting, was a very valuable one by Mr. Marlatt, of the Division of Entomology, Washington, entitled "Notes on Insecticides," from which the following extracts are taken:

SOAP AS AN INSECTICIDE.

There is no more unsatisfactory substance to work with against insects than soap, for the reason, previously pointed out, of the extreme uncertainty of the composition and characteristics of any brand that is secured. The most earnest efforts on our part to get manufacturers to make a definite brand of soap which approached our ideal, and to keep the stock at a uniform and reliable strength and character, have been entirely unsuccessful, and we have not been able to get any two consecutive lots of soap having the same characteristics or value for insecticide purposes.

PURE KEROSENE.

The discussion of this substance at the last meeting of the Association led to some additional experiments on our part with the use ot pure coal oil or kerosene on plants. Various trees, including young and vigorous peach, pear, cherry and apple trees, euonymus bushes, and some old bearing peach trees, were thoroughly sprayed with pure kerosene early the past spring, with one exception, before the buds had begun to swell. In the case of two large bearing peach trees the blossom buds were swelling and opening and these trees were also badly infested with *Diaspis lanatus*. The other plants, with the exception of the euonymus bushes, were healthy and free from all insects Much to my surprise and astonishment, no ill effects of any moment resulted in the case of any of the trees sprayed with kerosene. In the case of all the trees spraying was continued just long enough to moisten the plants thoroughly, but not to cause the oil to run down the trunks and collect about the base, and with the young trees the soil was carefully mounded up and pressed about the crown to avoid all danger of the oil collecting at that point.

The pear trees treated, and also the peach, came out in full bloom, the opening of the blossom buds not being at all interfered with by the oil bath. After the bloom fell the peach trees treated with pure oil made much finer growth than untreated trees. This may have been in part due to the more favorable location of the trees, and possibly also to the fact that in the treatment with the coal oil the eggs of Aphides on the trees had been entirely killed, whereas on the untreated trees a very bad infestation with plant lice developed early and checked the growth of the trees, killing some of them. No Aphides, however, appeared on the sprayed trees. In the case of the pear trees particularly, and also the apple, the unfolding of the leaf buds was very noticeably delayed as compared with untreated plants, the buds seeming to open up much more slowly, and for two weeks at least the difference was very marked. Very soon thereafter, however, the treated trees overtopped the others both in abundance of foliage and amount of new growth, and at the present writing, July 20, there seems to have been no injury whatever as a result of the treatment.

The large peach tree sprayed showed no ill effects, and all of the scales on the tree were killed except where they had been protected in a few instances by masses of leaves webbed about the limbs. At least 99 per cent. of the scales were killed. On the euonymous a similar result was shown, at least 99 per cent. of scales having also been killed by the oil.

These results are so greatly in contrast with those previously attained in the experiments conducted in practically the same way that it seems difficult to account for them. That spraying with pure oil will often kill trees can not be doubted, even when applied in the dormant condition in winter, as demonstrated by experiments on a number of apple and peach trees two or three seasons ago. It is possible that with these earlier experiments the same care was not employed to prevent the collection of oil about the trunks of the trees and the trees were not mounded up, but the work was as carefully done as would ordinarily be the case in actual practice, and probably much more so. It is possible, therefore, that the death of the trees in some instances was due to the collection of the oil in the cavity formed about the trunk by the swaying of the trees in the wind, which, as will be shown later, has had disastrous results in California with the emulsion even. Others have reported the use of oil on trees without injurious effects in some instances and in others with injurious effects, so that pure oil as an insecticide is one to be used with caution and with full appreciation of the fact that the death of the plant may result.

USE OF KEROSENE EMULSION IN CALIFORNIA.

This insecticide is used to a very considerable extent in California, much more so in recent years than formerly. It is the principal insecticide used in the district about San Diego, and is also used extensively at Santa Barbara and to a less extent elsewhere in the State. The necessity for the use of very large quantities of insecticides in California has led to the establishment by private parties in several instances of steam or gasoline plants for the wholesale production of this insecticide. Probably the first extensive manufacturing plant of this sort was set up by Mr. W. R. Gunnis, county horticultural commissioner, of San Diego, who manufactures the emulsion by the aid of a small engine, doing all the work of heating, churning, etc., by this means. With coal oil at 11 cents per gallon, he is able to produce the emulsion at a charge of 13 cents per gallon in the undiluted state, which makes the wash as applied to the trees, diuted 7 times, cost a little over 1½ cents per gallon. In his district, Mr. Gunnis claims that the loss from scale insects has been reduced from 79 per cent. to 7 per cent., chiefly by the use of this wash.

At Santa Barbara the superintendent of the Las Fuentos ranch, Mr. Frank Kahles, has set up a very large plant for the manufacture of kerosene emulsion for the use of this ranch alone. The plant is similar to that devised by Mr. Gunnis, and the capacity is such that the emulsion can be made in quantities of 150 gallons at a time and very rapidly. He uses a formula slightly different from the Hubbard. The proportions are 35 gallons of whale-oil soap, 100 gallons of kerosene oil, and 50 gallons of water. This is diluted for application to trees with seven parts water, costing in the diluted state 1⅝ cents per gallon.

Kerosene emulsion has probably been given its most extensive trial on the Pacific Coast at the Las Fuentos ranch. Two years since Mr. Gunnings sent his excellent spraying apparatus to Santa Barbara, together with some 8,000 or 10,000 gallons of emulsion, and thoroughly sprayed the lemon plantings, comprising upward of 25,000 trees.

In some of the earlier work many trees were killed, owing probably to the accumulation of oil in the bottom of the reservoir or tank, so that the last three or four trees with each filling received an unusually heavy dose, which, running down the trunk, collected in the cavity about the crown caused by the swaying of the trees in the wind. The accumulation of oil in this way may be prevented by giving the tank a conical bottom, so that the liquid may be thoroughly exhausted each time before refilling, and as a further precaution, before treating, the trees may be mounded up about the base and the earth thoroughly compacted. With these precautions no injury has resulted from the later sprayings. The treatment kills the young of the black scale and the fungus breaks up and soon peels off.

LIME, SALT, AND SULPHUR WASH.

As the members of the Association are aware, this is the almost invariable remedy for the San José scale on the Pacific slope, and as a rule it is undoubtedly effective. Our experience with this wash in the East had thrown doubt on its real efficiency as an insecticide, and it has been clearly demonstrated that under the climatic conditions east of the Alleghanies it is almost valueless. In California, however, after a careful study of the facts in the field, I am compelled to admit that the demonstration of its usefulness against the San José scale is complete and the benefit of its application to orchards is most manifest. In the vicinity of Pomona, Cal., unsprayed orchards were badly infested with San José scale, while in adjoining sprayed orchards the scale was entirely killed and the trees were rapidly recovering and showing vigorous and healthy new growth. In contiguous orchards, also, of the same kinds of trees, similarly treated so far as cultivation is concerned, the trees which had been subjected to yearly spraying were at least one-third larger than untreated trees. This wash is of value also as a fungicide, protecting stone fruits from leaf fungi, and is also a protection against birds, the common California linnet doing great damage to buds in January and February. The wash is almost invariably made and applied by contractors, and costs about 5 cents per gallon applied to the trees. It is a winter application, being applied in January and February.

Along the coast region and in northern California, where moister conditions prevail, this wash is very much less successful, bearing out somewhat the experience of the East, and doubtless explained by the similarity of climate in the districts mentioned with that of the Atlantic seaboard In making this wash the chief consideration seems to be prolonged boiling. The wash itself is practically a sulphide of lime, with much free lime and salt carried with it. Prolonged boiling will result in taking up temporarily additional sulphur, and will perhaps add to its caustic properties if it is applied very hot; on cooling, however, it reverts to the simpler tri- or bi-sulphide of lime. The proportions of the ingredients and the method of combining them vary slightly in different sections. The following is the ordinary formula: Unslaked lime, 40 pounds; sulphur, 20 pounds; salt, 15 pounds; one-fourth of the lime is first slaked and boiled with the sulphur in 20 gallons of water for two or three hours; the remainder of the lime is slaked and together with the salt is added to the hot mixture and the whole boiled for half an hour or an hour longer. Water is then added to make 60 gallons of wash. This wash is applied practically every year, or as often as the San José scale manifests itself in any numbers. In the coast region and in the northern part of the State it is necessary to apply it with greater frequency than in the interior districts.

ARSENICALS AND LIME.

The advantage of the employment of lime with Paris green or London purple having been called in question at the previous meeting of this association, the matter was again made the subject of experimental test, and the old belief of the decided protective value to the foliage of the addition of lime was fully and strikingly demonstrated.

At the final adjournment of the session it was voted to hold the next meeting at Boston, Mass., Aug. 19th and 20th.

Several resolutions were passed, among which were (1) a resolution requesting the publication of the proceedings as a bulletin of the Division of Entomology, U. S. Dept. of Agriculture and (2) expressing familiarity with the efforts of the State of Massachusetts to exterminate the gypsy moth and commending the results already accomplished.

The election of officers resulted as follows:—President, Herbert Osborn, Ames, Iowa; 1st Vice-president, Lawrence Bruner, Lincoln, Neb.; 2nd Vice president, C. P. Gillette, Ft. Collins, Colo.; Secretary and Treasurer, C. L. Marlatt, Washington, D. C.

JAMES FLETCHER, LL.D., F.R.S.C, F.L.S.

We are happy to be able to prefix to our twenty-eighth Annual Report, an excellent portrait of DR. JAMES FLETCHER, whose name is a household word among Entomologists not only in Canada, but throughout North America, and in many parts of the world besides. Born and educated in England, Dr. Fletcher came to this country when a young man as a junior officer in the Bank of British North America, and soon began to devote his leisure hours to the study of insects and plants. Find the work of a bank by no means congenial to his literary and scientific tastes, he obtained a position as assistant in the Library of Parliament at Ottawa. It was not long before his talents and attainments in botany and entomology became widely known, chiefly through his contributions to the *Canadian Entomologist* and the Annual Reports of our Society. His first paper in the latter was an article on Canadian Buprestidæ, which was published in 1878, while his first contribution to the Magazine appeared in January 1880. During all the years that have followed no volume of either publication has been issued without some valuable articles from his pen.

In 1878 he became a member of the Council of the Entomological Society of Ontario and every year since has been elected to hold some office in the Society, being four times Vice-president and for three years, 1886-8, President. In 1879 he was one of the originators of the Ottawa Field Naturalists' Club, the most successful society of the kind in the Dominion, and more recently he suggested, and by his influence and energy, accomplished the formation of the important Association of Economic Entomologists of North America.

The first official recognition of his attainments was in 1885, when he was appointed Honorary Entomologist to the Department of Agriculture at Ottawa, and in that capacity, though much hampered by his duties in the library, he published a valuable report on the injurious insects of the year. Two years later his present position of Entomologist and Botanist to the experimental farms of the Dominion was conferred upon him. In the ten years that have now gone by, he has done an enormous amount of valuable work as shown in his Annual Reports and Evidence before the Standing Committee of the House of Commons on Agriculture, his voluminous correspondence with farmers and fruit growers all over the Dominion, and his addresses to Farmers' Institutes and other gatherings. No one in this country has done so much as he to instruct the people in a practical knowledge of their worst insect foes and the best methods of dealing with them, while probably no one but he could have given the Province of Manitoba the information and the advice that he has repeatedly afforded by his lectures, addresses and publications on the noxious weeds of that portion of the Dominion. All his friends will, we are sure, unite with us in the earnest wish that he may long be spared to carry on his admirable work which is of such vast importance, not only to those directly interested in the products of the soil, but to all the dwellers throughout this wide Dominion.

C. J. S. B.

BOOK NOTICES.

INSECT LIFE; AN INTRODUCTION TO NATURE-STUDY AND A GUIDE FOR TEACHERS, STUDENTS AND OTHERS INTERESTED IN OUT-OF-DOOR LIFE: By John Henry Comstock, Professor of Entomology, in Cornell University and in Leland Stanford Junior University, with many illustrations engraved by Anne Botsford Comstock. New York, D. Appleton and Company, pp. 340, with 6 plates and many figures. Price $2.50.

In this little book Prof. Comstock has given us a treatise, not only of practical value to teachers and amateurs, but also one that the professional worker will find very handy to have just within reach in order to settle some minor point that may suddenly present itself. Best of all, however, is the fact that the work is correct, a feature quite in contrast with some of the ordinary text-book entomology. There need be no hesitation about recommending this book to anyone, as its style, while not especially technical, is even more or less poetical, yet is never flippant or slipshod in expression. The illustrations are fine and are not simply pictures, but help to simplify the text; almost anyone who is at all versed in entomology will at once recognize the Katy-did on the cover. There is just one fault to bo found with the book, and it is very doubtful if this is to be attributed to the author, and this is the title. A fascinating title may help to sell a novel, or some such work as that, but publishers should learn that this is not true with such books as this. However, it is no discredit to the author that his book should be found better than its title. For the present, and until there is something much better, I shall recommend this book to those who wish a simple and accurate introduction to the difficult study of entomology. F. M. W.

STORIES OF INSECT LIFE: By Clarence Moores Weed, Ginn and Company, publishers, Boston, U.S.A, and London, pp. 54, with many illustrations. Price 25c.

The title indicates the nature of the book, and no one will mistake the figure of the well known "Mourning Cloak" Butterfly on the front cover, even though no attempt was made in the way of colour. This is for the young people, and just the thing for boys and girls who are romping and playing over the fields and meadows, securing that most important element in an education, health. The insects treated of are the most common, and this is a great advantage because it is usually the things that are the nearest to us that we know the least about. Get the children to observe the common things carefully, and they will be all the better prepared to look after the uncommon later on in life. I only wish that some philanthropist would buy up the whole edition of this work and present them to the school children of the country. Surely it would help to make better men and women of many boys and girls, and open up them a world of wonders that are to be seen by any, no matter how lowly, provided they only know how and where to look. F. M. W.

GUIDE TO THE GENERA AND CLASSIFICATION OF THE NORTH AMERICAN ORTHOPTERA: By S. H. Scudder. 8vo. pp. 89. W. H. Wheeler, Cambridge, 1897. Price, $1.00.

The above volume, like all of Dr. Scudder's books, is exactly what the title states. It is simply a guide for the use of students of the Orthoptera by means of which they may determine the genera of their specimens. It consists of excellent and most carefully prepared tables of the seven families into which the Orthoptera of North America are divided. These are followed by most valuable bibliographical notes in which the student is referred under the head of each family of insects to all the works which refer to it. Then follows a full list of all the works which refer to North American Orthoptera, arranged alphabetically by authors and a complete index. All who have attempted to study Orthoptera know how badly such a book was wanted, and it is well for the science of entomology that the work was done by such a careful and experienced hand.

J. F.

THE GENERA OF NORTH AMERICAN MELANOPLI: By S. H. Scudder. (Proc. Am. Acad. of A. and S. V. 32, pp. 195-206, January, 1897.)

Almost simultaneously with Dr. Scudder's "Guide to the Genera of Orthoptera" two other important and extremely useful papers appeared, one on "*The Genera of North American Melanopli*," and the other on "*The Species of the Genus Melanoplus*." These are both really advance issues of chapters in Dr. Scudder's great work on the Melanopli, which is to be published by the U. S. National Museum. The *Melanopli* are divided into thirty genera, seventeen of which are new and four have been previously published by the author. The genus *Melanoplus* is characteristically American and is widely disseminated. There are 131 species recognized, grouped under twenty-eight series. The name *furcula* is given to the processes of the last dorsal segment of the male abdomen. J. F.

THE BOOK OF BRITISH BUTTERFLIES: A practical manual for Collectors and Naturalists; 1 vol. pp. 247 (3s. 6d.)

THE BOOK OF BRITISH HAWK-MOTHS: A popular and practical Hand-book for Lepidopterists; 1 vol. pp. 157 (3s. 6d.)

By W. J. Lucas, B. A. London: L. Upcott Gill, 170 Strand, W. C.

Many excellent works on British butterflies have been published during the last twenty-five years and one would naturally suppose that there was little need of another book on the subject. Mr. Lucas, however, has succeeded in producing a very useful and excellent popular manual, which will be a welcome aid to those who wish to study the life history of butterflies as well as to identify the specimens they may collect in the British Isles. As it is intended for those who have made no previous study of the subject, the author begins at the beginning, telling the reader what an insect is, what place the butterfly takes in nature, how to capture, set and care for specimens, and then describes each British species from the egg to the imago in clear and simple language, and in almost every instance gives admirable drawings of the caterpillar, chrysalis and both surfaces of the imago. As there are no less than 266 figures in illustration of sixty-eight species, the collector should have no difficulty in determining any specimen of butterfly in any of its stages (except the egg) that he may chance to find. A book such as this should give a great impetus to the study of the preparatory stages of British butterflies, a section of entomology which is usually neglected in favor of the mere collection and arrangement of the perfect insects. A volume such as this on Canadian butterflies would be a very welcome aid to a large number of young people whose interest has been aroused by the beauty and variety of our species, but whose enthusiasm is dampened by the difficulty of obtaining any information about them.

"The Book of British Hawk-moths," by the same author, deals with a somewhat less familiar group, and gives much useful information that it would otherwise be hard to find. The plan of the work is similar to that of the butterfly book, and it is written in the same clear and simple style. As there are only seventeen species to deal with, the writer is able to go more fully into details respecting them and to make his work all the more complete and popular. He has also provided artificial keys to the larvæ and imagines, and tables for distinguishing the species where there is more than one representative of the genus. The fifteen plates with which the volume is illustrated are very beautiful and are admirably drawn by the author himself. Each species is represented life size, and is shown as a caterpillar on its food plant, chrysalis and imago. There are eighteen wood cuts for the most part illustrating details of structure. It is to be hoped that the author will continue his good work until he has completed the British lepidoptera, or at any rate the more conspicuous and familiar families. C. J. S. B.

LIFE HISTORIES OF AMERICAN INSECTS: By Clarence M. Weed. 1 vol. pp. 272. ($1.50). New York: The Macmillan Company.

The publication of a popular book on insects is so rare an event on this side of the Atlantic that we heartily welcome an addition to the number, especially when it is so excellent and satisfactory as the volume before us. Dr. Weed has selected some five and twenty more or less familiar insects, and in a pleasant manner has given some account of their life histories. The chapters are quite independent of each other and arranged in no particular order; the book may therefore be opened at random, and the sketch that may be hit upon read without any detriment to the continuity of the work. Some of them which deal with such creatures as the leaf miners are naturally very brief since so little is known about these tiny foes to vegetation, but of other species which have been subjects of particular study on the part of the author we find long and full descriptions. Among the latter may be mentioned the interesting account of the hibernation of aphides, the chapter on "harvest spiders, the "army worm," etc. Any-one, young or old, who has any desire to read about the wonderful creatures that inhabit the world and to know something about their modes of life cannot fail to be pleased with this book, and to be led on we should hope to make his own observations of their curious habits and strange doings. The volume is handsomely illustrated with twenty-one full page plates and nearly 100 figures in the text. C. J. S. B.

INSECTS AND SPIDERS: Their Structure, Life Histories and Habits. By J. W. Tutt. 1 vol., pp. 116. (1 shilling). London: George Gill & Sons, Warwick Lane, E.C.

In the annual report of the Entomological Society of Ontario for 1896 much attention was paid to the subject of teaching natural history, and especially entomology, in schools, and the desire was expressed that some hand book might be drawn up for the assistance of teachers in rural schools. The volume before us is the very book that is needed, if only it dealt with Canadian instead of British insects. In England "Object lessons" are a compulsory part of the curriculum in elementary schools, and the teachers are required to give their pupils a series of simple lessons "adapted to cultivate habits of exact observation, statement and reasoning." These lessons are to be "on objects and on the phenomena of nature and of common life," and a wide discretion is thus left in the hands of the teacher. In the country schools of Ontario no subject could be more useful than the study in this way of the commonest species of injurious and beneficial insects, and no subject is likely to compare with it in interesting the pupils. A further advantage is the ease with which specimens can be obtained and their life histories traced. Mr. Tutt's volume is admirably adapted for the use of teachers in providing lessons of this kind. After giving a general account of the external structure of insects, their internal organs and metamorphoses, he devotes the "lessons" to typical common species of each order, giving similar particulars regarding the individuals and any general facts of interest that bear upon them. Each insect treated of is also illustrated with plates and wood cuts. It is not, however, a text-book for pupils, but is meant for the instruction and equipment of the teachers, affording them an excellent foundation upon which to frame the instructions they are to give to those committed to their charge.

C. J. S. B.

SUPPLEMENT.

AN ACT TO PROTECT CANADA AGAINST THE INTRODUCTION OF THE INSECT PEST KNOWN AS THE SAN JOSÉ SCALE.

Assented to March 18th, 1898.

Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows :—

Short title.

1. This Act may be cited as *The San Jose Scale Act.*

Importation of nursery stock from certain places prohibited.

2. The importation of any trees, shrubs, plants, vines, grafts, cuttings or buds, commonly called nursery stock, from any country or place to which this Act applies is prohibited.

Penalty.

3. Any nursery stock so imported shall be forfeited to the Crown, and may be destroyed, and any person importing nursery stock from any such country or place, or causing or permitting it to be so imported, shall be deemed to be guilty of an offence under section 6 of *The Customs Tariff, 1897*, and shall be liable to the penalty prescribed by that section.

Application of Act to be regulated by Governor in Council.

4. The Governor in Council may from time to time declare that this Act applies to any country or place as to which it has been made to appear that San José Scale exists therein ; and, when satisfied that the importation of nursery stock from any country or place to which this Act has been applied may safely be permitted, he may in like manner declare that this Act no longer applies to such country or place.

Exemption of plants which are not liable to San José Scale.

5. The Governor in Council, upon its being made to appear to his satisfaction that any class of plants is not liable to the attack of the San José Scale, may exempt plants of such class, and grafts, cuttings or buds thereof from the operation of this Act.

Importation for scientific purposes.

6. The Governor in Council may from time to time, notwithstanding anything contained in this Act, permit the importation from any country or place to which this Act applies, of any such nursery stock as is required for scientific purposes.

Publication of Orders-in-Council.

7. All Orders in Council made under sections 4 and 5 of this Act shall be published in *The Canada Gazette.*

ORDERS IN COUNCIL.

At the Government House at Ottawa,
Friday, the 18th day of March, 1898.

PRESENT : HIS EXCELLENCY THE GOVERNOR-GENERAL IN COUNCIL.

His Excellency, in virtue of the provisions of section 4 of the Act passed during the present session of Parliament, cited as "The San José Scale Act," and by and with the advice of the Queen's Privy Council, is pleased to declare that the United States of America, Australia, Japan and the Hawaiian Islands shall be and the same are hereby declared to be countries to which this Act applies owing to the existence of the San José Scale in them.

JOHN J. MCGEE,
Clerk of the Privy Council.

At the Government House at Ottawa,
Friday, the 18th day of March, 1898.

PRESENT: HIS EXCELLENCY THE GOVERNOR-GENERAL IN COUNCIL.

His Excellency, in virtue of the provisions of section 5 of the Act passed during the present session of Parliament, and cited as "The San José Scale Act," and by and with the advice of the Queen's Privy Council, is pleased to order and declare that the following plants which are not liable to the attack of the San José Scale, viz.:—

1. Greenhouse plants, with the exception of roses,
2. Herbaceous perennials,
3. Herbaceous bedding plants,
4. All conifers,
5. Bulbs and tubers,

shall be and the same are hereby exempted from the operations of the above mentioned Act.

JOHN J. MCGEE,
Clerk of the Privy Council.

ONTARIO DEPARTMENT OF AGRICULTURE.

AN ACT TO PREVENT THE SPREAD OF THE SAN JOSE SCALE.

Passed January 17th, 1898.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. This Act may be cited as *The San Jose Scale Act.* Short title.

2. In this Act the word "Minister" shall mean the Minister of Agriculture for the Province of Ontario. Interpretation "Minister."

The word "plant" shall mean any tree, vine, shrub or plant, or any part of a tree, vine, shrub or plant, or the fruit of any tree, vine, shrub or plant. "Plant."

The word "scale" shall mean the San José Scale insect in any of its stages of development. "Scale."

3. No person shall import or bring, or cause to be imported or brought into the Province of Ontario, for any purpose whatsoever, any plant infested with scale. Importation of diseased plants prohibited.

4. No person shall keep or have, or offer for exchange or sale, any plant infested with scale. Having in possession or selling.

5. For the purpose of scientific investigation the Minister may from time to time, by writing given under his hand, except such persons as he may deem proper, from the operation of the two preceding sections, and, while acting under such permission, such persons shall not be subject to the penalties imposed by this Act. Scientific investigation.

6. Any person having reason to suspect that any plant in his possession, or in his charge or keeping, is infested with the scale shall forthwith communicate with the Minister in regard to the same, and shall furnish the Minister with all such information in regard to the source or origin of the said infestation and the extent and nature of the same as he may be able to give. Notice to Minister on discovery of disease.

Investigation and report.

Destruction of diseased plant.

7. Whenever the scale exists, or is supposed to exist on any plant, the Minister may direct a competent person to make an examination and inspection, and may order that any plant so infested, or such part as he may deem advisable, shall be immediately destroyed by burning, either by the person appointed to make the inspection or by the person owning or having possession of the said plant, or some other person so directed in writing, and the person so directed shall make a full report to the Minister in writing as to the nature and extent of the work so performed, together with a fair estimate of the value of the plant destroyed.

Duties of inspectors appointed under Rev. Stat. c. 280.

8. For the purpose of enforcing this Act, it shall be the duty of every inspector appointed under *The Yellows and Black Knot Act* to make careful examination and inspection for the occurrence of the scale within the municipality for which he is appointed, and to report forthwith every case of infestation, and neglect to make such report shall render the inspector liable to the penalties imposed under section 11 of this Act.

Right of access to places where tree is.

9. Any person appointed by the Minister under this Act to inspect or to destroy any plant for the purpose of enforcing the provisions of this Act, shall, upon producing his authority in writing, have free access to any nursery, orchard, store, storeroom or other place where it is known or suspected that any plant is kept.

Compensation for destruction of plants.

10. Upon the recommendation of the Minister there may be paid out of the Consolidated Revenue Fund of the Province to the owner of any plant so destroyed a sum not exceeding one-fourth of the value thereof (not including fruit) as reported upon by such officer or other competent person appointed as aforesaid; but nothing in this section shall apply to any plant imported into the Province within a period of one year prior to the examination by the officer aforesaid.

Penalty.

11. Any person neglecting to carry out the provisions of this Act, or any person offering any hindrance to the carrying out of this Act, shall, upon summary conviction, be liable to a fine of not less than $20 nor more than $100, together with costs, and in default of payment thereof shall be subject to imprisonment in the common gaol for a period of not less than ten days nor more than thirty days.

Extension of Act to other scale insects.

12. The Lieutenant-Governor in Council may by order direct that other scale insects than the San José Scale may be included in the provisions of this Act, and thereafter during the continuance of such Order-in-Council the word "scale" in this Act shall include all such other scale insects. Public notice of such Order in-Council shall be given by publication in two successive issues of *The Ontario Gazette.*

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